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## Dr. Thomas Quayle's Report, 1936–37

THIS document has more than official interest. While those parts of the report dealing with statistics and the general details of the office procedure have an importance of their own, we think that the section, devoted to the consideration of the fundamental problems arising from the residence of a large population of Indian students in Great Britain, deserves special attention. During the period under report there were approximately 1,850 students, distributed all over the University towns throughout Great Britain and Ireland, and this number represents by far the largest single national group which is nearly 70 per cent. of the total from the whole British Empire, and probably nearly 40 per cent. of the combined total numbers of the British Empire and foreign students. Far from showing any symptoms of decreasing, these numbers indicate a marked tendency to increase by the growing volume of the exodus of students from India from year to year. They are not discouraged by the failure of their "returned" compatriots to find suitable employment, though the latter may have earned excellent distinctions in the foreign universities. The cheerful optimism that a foreign degree will considerably swell their value and enhance their prospect of preferment in India underlies the spirit of the annual emigration of young men to Europe. It may be pathetic. It need not be surprising. So long as Government

encourages and upholds the doctrine that academic distinctions in the universities imply a corresponding degree of efficiency in the administrative fields, young men cannot be blamed for cherishing the belief that their salvation lies in acquiring higher qualifications in formal studies at a university abroad. The unemployment of these highly educated young men is a grave problem, and its solution confronts Government and society with issues far more serious than those arising from the unemployed young men turned out by the home universities.

The following passage extracted from the report is interesting in several particulars:

> "It is not too much to say that what is sometimes called in this country the 'Indian student problem' is a matter of vital importance from the Imperial point of view. Whatever the future may have in store, it is indubitable that for the present, and probably for long years to come, India, however marked the progress in its available facilities for advance and research work in all branches, will look to the Occident, and especially let us hope, to this country, for the further intellectual stimulus and training of the best of her sons. And if this assumption be well founded, all the greater obligation will rest on the Government and people of this country to ensure that the young Indians who come are helped in every possible and practicable way to get the best out of their sojourn here, not merely from the view-point of the training and degrees which they obtain, but also from the most important aspect that they should be enabled to feel and find themselves, not merely strangers in a strange country, but members of a community ready to welcome them and to make them feel 'at home', so that they may return to India with experience and as interpreters of the best aspects of English life, both public and private. Such students,—and experience has amply proved how numerous, despite the inevitable failures and misfits,—will undoubtedly prove to be ambassadors of great worth, ready and willing to do all they can to foster the most friendly relations and understanding between the two peoples."

These are noble sentiments, though some of them may be construed as inscriptions on the monument of the modern standards of higher education in India, and others are distinguished for their piety and generous enthusiasm. The implications of this passage are categorically, that the university education in India is definitely inferior, that higher training and a degree in a British University are indispensable for advanced research work in India and that if young Indians are treated with hospitality by the British people, they will establish cordiality of feeling between the two peoples. We suppose that it is pertinent to ask "Who is responsible for the low standard of Indian Universities? What about the standards of Universities in the self-governing Colonies and Dominions?" It is not quite clear to us how higher training in a foreign university confers on its recipient the faculty of undertaking research work of an advanced character. It must be gratefully acknowledged that those who have acquired distinctions at an English or European University have done work often of signal importance and by its merit, such work has been the means of example and inspiration for others. We must also admit with equal frankness that others who had not received the benefits of this superior education, have not permitted their grave misfortune to stand in the way of scientific enquiry and investigation, and their record of work is equally impressive and important. Is it really supposed that the Indian graduates of British Universities, failing to obtain suitable employment and openings

for reimbursing the depleted family funds, will become itinerant preachers spreading in their country the gospel of good-will and fellowship. While remembering gratefully all the efforts made towards promoting their happiness and comfort during the trying periods of life abroad, the Indian students returning to their country naturally look forward for engagements which would be advantageous to themselves and useful to their employers.

Dr. Quayle makes a passing reference to the grievous complaint against the inequity in respect of dispensing overseas scholarships. It may be necessary to rouse the public opinion in Britain to the importance of ensuring that Indian students should have the amplest opportunities of becoming acquainted with the best side of English home and family life, but that the same public opinion both in India and in England should be intensely agitated over the injustice perpetrated by the Royal Commission for the Exhibition of 1851, regarding the award of scholarships under their scheme of Overseas Science Research. Till 1937, India was totally excluded, though the contribution from Indian public revenues for this fund was voluntary and generous, and in that year a solitary scholarship was awarded, and in 1938, two scholarships were granted. It will be remembered that during this whole period extending over two generations, the Dominions and Crown Colonies almost exclusively enjoyed the monopoly, in addition to other important Empire Scholarships. The report observes that "if Indians, in common with other overseas students, could become eligible for such scholarships, and if financial assistance, in some measure at least, from official sources in this country were also made available for the best men from the Indian Universities, to enable them to come here for research or advanced course of study, it would in my view strike a note which would be warmly appreciated and welcomed by Indian opinion". What is wanted is not an expression of excellent sentiments, but the adoption of energetic steps to get the long-standing injustice redressed. By ignoring the claims of India to participating in the benefits of these scholarships, the authorities who are charged with the responsibilities of awarding them, have definitely placed India in a most unenviable position, for which there can be no conceivable justification, and from which she can be extricated by the Inter-University Board acting with spirit and in time in collaboration with the High Commissioner for India. Their joint action should be supported by a well-organised public opinion from the responsible leaders of the cultural life of India, insisting on equity and fair play to their gifted young men.

There is another significant passage in the report which we should like to quote not only for its general importance, but also for its practical bearings: "It is no exaggeration to say, as has been constantly reiterated in these Reports, that India ultimately gains little or nothing, either materially or intellectually, from an appreciable proportion of her young students who annually proceed abroad, and it can scarcely be denied that each year there is a grave wastage which calls for the most earnest consideration." This inability to derive any benefit from their sojourn in Britain is attributed to the fact that many students are not fitted by physique, temperament, training and the assurance of adequate financial resources profitably to prosecute further studies in the West. The remedy proposed to combat this wastage, is to foster the growth of a strong public opinion by Government and the Universities for discouraging the annual migration of such misfits. The implication of the passage we have quoted would seem that

Indian students more favourably endowed, have, on their return from foreign studies, contributed largely to the material progress and the cultural advancement of their country. It is so. But we doubt if it is so as a result of their residence abroad. There is more truth in the general statement "that the young Indian student who leaves his own country for further study or training abroad apparently continues to do so in the belief, only too often encouraged by parents at considerable sacrifice to themselves that on his return his chances of suitable remunerative employment will be considerably increased". The reaction of the young Indian student to the strange and new surroundings, complex and foreign, can be explained only on the basis of his psychological make-up.

Indian students when they leave their parental houses, may be reasonably supposed to have attained the age of mental maturity, duly fortified by the sobering discipline of family life and by the exacting demands of those responsible for his instruction. However, lurking behind his character there are the persistent remains of an instinctive sensitiveness and imaginative sympathy which, when confronted with a bewildering multitude of new social phenomena, and of strange attractions of new points of view, must inevitably disturb and produce even instability of mind. He can hardly struggle out of "the web of the obligations of the family life," nor does he completely throw off his traditional loyalty to the social system with its sanctions and disciplines. His cultural inheritance renders his temperament cautious and conservative, inaccessible to unexpected stimulus. When thrown into the vortex of a virile and unfamiliar civilization, the young man is naturally in a painful dilemma, with his loyalty divided between the attractions of "an agitating social and political institution charged with feeling and aspiration" and the convictions of the moral certainty of his social philosophy and racial tradition. This tension in thought produced by the dual appeal of Western influence and of Indian culture must account for the manifestations of zeal and energy for the social institutions of Europe on the part of some young men, more self-confident than their compatriots, and for the grievances and humiliations of others whose response to the new surroundings must be "involuntary rather than deliberate". Though these two types of young men cannot be presumed to be entirely insensible to some of the influences of the Western political and social ideals, it is too much to suppose that they are fully conscious of their deeper significance to the traditions of Indian cultural institutions and the philosophy of ultimate human values, which they have imbibed from infancy. It is true that the eddying currents of Western civilization are gradually overflowing the backwaters of Indian life and thought, and if India becomes submerged and ultimately forfeits her power of rolling back all the flotsam and jetsam brought by these currents, she must inevitably lose her ancient character, as the deliverer of the message of peace, harmony and understanding. Who would be responsible for stripping her of this power?

"Is it just possible" Doremus Jessup sighed, "that the most vigorous and boldest idealists have been the worst enemies of human progress, instead of its greatest creators? Possible that plain men with the humble trait of minding their own business will rank higher in the heavenly hierarchy than all the plumed souls who have shoved their way in among the masses and insisted on saving them."

# Parasitism in Insects

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## Introduction

MOST animals have their natural enemies which are usually grouped into two classes: predators and parasites. The former only attack for food and after feeding for a short while on their victims, which are usually killed in the process, give them up. The latter may attack for egg-laying as well as for food and their association with their victims is of a more permanent nature and generally lasts till the parasite reaches the adult stage. The distinction between predators and parasites is sometimes arbitrary and many workers often regard them as merely two extreme examples of a type of life in which one insect lives at the expense of another.

Parasitism is more common among insects than perhaps in any other group of the animal kingdom with the exception of the helminth worms. In its simplest form one insect parasitises another which is not a parasite (primary parasitism). When the attacked insect is itself already a parasite the phenomenon is known as hyper- or secondary parasitism. Sometimes two or more species of insects attack the same host simultaneously leading to multiple parasitism or, according to some authors, superparasitism, though the latter term is better restricted to cases where the attacking insects belong to the same species. Most dipterous and hymenopterous parasites often eventually destroy their hosts and, on this account, are termed by some authors as 'parasitoids' to distinguish them from other parasites whose presence to their hosts usually does not prove fatal.

## Origin of Parasitism

It is generally believed that insect parasites originally evolved from free living and phytophagous forms which took the first step towards a parasitic existence by living in harmless association with other animals. Later, physical proximity, habits of cannibalism, which gradually widened to include other species, a kind of rough similarity between certain plant and animal foods, such as lichens, coccids, etc., induced one insect to feed on the other. The predatory habit thus acquired was maintained so long as the predator did not find enough nourishment on one host and had to attack several of them but if the host was large enough to supply the full requirements of its enemy the necessity for changing the host vanished and a more lasting association leading to a parasitic mode of life came into existence. A border-line case is that of two micro-moths, *Zenodochium coccivorella* Ch., and *Euclemensia bassettella* Cl. which parasitise coccid hosts (*Kermes* sp.). The caterpillars of these moths each live on a single *Kermes* individual though the latter's substance is hardly adequate to sustain the parasite till it is full grown. It is conceivable that the caterpillar would have had to attack more than one host if the substance afforded by a single host was much under requirement. In other words, parasitism here is only just in advance of predatism (Balduf, 1938).

Parasitic life among Epipyropidæ, a group of small moths, seems to have evolved in an analogous manner. It is now certain that the ancestors of these moths were phytophagous and fed on plant juices as do their homopterous hosts of to-day. The epipyropid caterpillars found equally palatable food in the anal and other excretions of the homopterous insects living alongside with them, from which it was a short step to living on the bodies of the latter and not only obtain their excretions very much near at hand but also get the benefit of shelter and transport. Parasitism in Epipyropidæ, therefore, is considered to be of a very simple order, not advanced yet to the higher specialisations of efficient parasites (Balduf, *op. cit.*).

Change in feeding habit led to change in body structure. In the attacking insect certain morphological characters became unnecessary and in turn certain others were developed to suit its new requirements. The bed bug and the flea, for instance, seem to have lost their wings as a result of parasitic existence. Among bird lice the eyes are greatly reduced or even absent,

obviously because, living as they do on the cuticle and feathers of birds, they hardly need them. In many first instar hymenopterous larvæ there is complete absence or at least feeble development of the spiracles and the tracheal system and respiration is cutaneous, the blood of the host providing the necessary oxygen. An anal vesicle or caudal appendage is present in the early instar larvæ of *Exochilum, Limnerium, Dinocampus, Meteorus,* etc., which is undoubtedly respiratory in function though it later gets absorbed in the body as the larvæ develop and begin respiring by means of spiracles.

Another view regards parasites not so much the creatures of necessity as the natural result of an intelligence in insects, with predatory instincts, following up an advantage. According to this view parasitism is an achievement in which the mode of living illustrates specialisation rather than degeneration. Obviously the greater the specialisation for extracting nourishment from the host for the longest period of time the more successful is the parasite. Indeed the perfect parasite will not kill its host as by doing so it will only starve itself, and the one that would kill its host will not be so well evolved as the other that would not. Hermes (1926) cited a number of cases to show that many parasites which habitually live and breed on their hosts are not so troublesome to the latter as those that attack only occasionally. The mosquito, *Anopheles maculipennis,* which is a vector of the causative organism of malaria, is 'benign' in its bite but *Aedes dorsalis,* a wild salt marsh species, is viciously irritating, though harmless.

## Some Types of Parasitism

From the standpoint of their feeding habits, parasites are divided into two categories: endoparasites, which feed inside the body of their hosts, *e.g.,* many dipterous and hymenopterous parasites, and ectoparasites which feed on but live outside the body of the host, *e.g.,* the ticks and lice of various birds and mammals and many braconid parasites of insects. Among insects Diptera and Hymenoptera provide the commonest examples of parasitism. Three families of beetles and two of moths also contain parasitic species while stylops or Strepsiptera are exclusively parasitic. Most ectoparasitic insects are drawn from the order Anoplura. In the groups just enumerated several families, *e.g.,* Cecidomyidæ, Anthomyidæ, Evanidæ, Cynipidæ, Staphylinidæ, etc., contain both predatory and parasitic species.

Parasites depend for their existence on their hosts and have, therefore, adapted themselves, in many cases very finely, to the habits and characters of the latter. Perhaps the most varied examples of adaptation are met with in the tachinid flies which include oviparous as well as larviparous species. In America the females of *Sturmia scutellata,* a parasite of the gypsy moth, lay their tiny black eggs on the foliage which are swallowed by the caterpillars and the hatching of the parasitic egg actually takes place inside the alimentary canal of the host. The females of another tachinid, *Prosena siberita* Fabr., a species widely distributed in Europe and Asia and introduced in America to control the Japanese beetle, deposit their larvæ on the soil which wander about till they find host larvæ into whose bodies they penetrate and develop. In such cases the parasitic larvæ have to be active migratory forms well adapted to seeking their hosts (Sweetman, 1936).

The majority of hymenopterous parasites, however, lay their eggs in or on the eggs, larvæ, pupæ and even adults of their hosts. Many species of Mymaridæ, Trichogrammidæ and Seclionidæ parasitise the eggs of various bugs, moths, butterflies, beetles, flies, grasshoppers, mantids, etc. One of the most important of the egg parasites, is the famous *Trichogramma minutum* (Riley), a cosmopolitan species parasitising an unusually large variety of hosts in the egg stage and employed extensively to control codling moth, moth borers of sugarcane and several other pests in various countries. Many braconids and ichneumonids parasitise the larvæ and pupæ of their hosts. *Melcha nursei Cam.,* a well-known parasite of the spotted bollworms of cotton in various parts of India, lays its eggs on the body of the host pupa by puncturing its cocoon. Parasitisation of the adult is rather less common than those of the immature stages but the braconid genera, *Perilitus* and *Dinocampus* are known to parasitise some adult beetles. An interesting case is that of a cecidomyid (*Endopsylla* sp.) in Scotland, which lays its eggs on the wings of *Psyllia mali* race

*peregrina*. The larvæ that hatch feed for sometime ectoparasitically on the body of the host and then bore into the abdomen near its base and develop endoparasitically till full grown when they come out of the body and pupate in the soil (Lal, 1934).

### Host Selection

The number of hosts which a parasite will attack is often limited and is at times confined to only one species which means that it exercises some discrimination when out for oviposition. Parasites must select their hosts and before they can select they must find them. It seems now generally agreed that the first concern of a parasite is not so much to seek a host as the particular type of environment in which it is likely to be present and then only to look for it. In doing this the parasite restricts the field of its search and increases the chances of its coming into contact with a suitable host.

The factors that guide parasites in host finding and host selection have been subjects of great controversy and some experimentation. It was believed by Thompson and Parker (1927) that the laws underlying the problems of host relations could not be scientifically ascertained and expressed in scientific terms, a view which was refuted by Salt (1935) as a result of his work on *Trichogramma evenescens*. Salt showed that the chief criterion which guided an ovipositing female of this species in selecting its host was that of size since out of several objects selected and attacked by the parasite many were unsuitable and from which no progeny could develop. More recently Laing (1937) has analysed the factors for host selection and concluded that not only *Trichogramma* but many other parasites, *e.g.*, *Alysia manducator*, are first attracted by the qualities of an environment irrespective of the fact whether their host happens to be present in it or not, but within the environment itself sense of sight is their chief guiding factor. To the extent that sight helps the parasites to distinguish size Laing's conclusions may be said to agree with those of Salt.

Ullyett (1936) on the other hand, working with the chalcid, *Microplectron fuscipennis* Zett., and its tenthredinid host, *Diprion* sp., showed that this parasite could exercise a high degree of discrimination between healthy hosts and those already containing well-grown parasitic larvæ, although a parasitised host merely harbouring an egg of the parasite was distinguished. This discrimination was ascribed to the presence or absence of movements of the host larva and it was also inferred that a definite proportion of every host population was not subject to random oviposition. Ullyett, therefore, concluded that "a wholly mechanistic view of host selection is untenable and that the underlying basis of behaviour is of a psychological nature".

### Effects of Parasitism on Hosts and Parasites

The presence of a parasite is undoubtedly inimical to its host but the extent of this injury varies widely, from simple annoyance to death. Most of the biting lice live upon their bird hosts for a long time merely causing deep irritation to their skin by the scratching action of the claws of their feet. Some parasites, although they themselves do not prove fatal to their hosts directly, may cause the latter's death by transmitting various disease germs. The louse, *Pediculus humanus* L., is known to transmit typhus and relapsing fevers and some other human diseases through punctures of the skin made with its mouth parts or by its infected excreta coming in contact with an abrasion on the skin. Many Ichneumonidæ, Bethylidæ, Scollidæ, Tiphiidæ, etc., habitually sting and paralyse their hosts before ovipositing in them and in the process even kill them. *Tiphia popilliavora* Roh., a parasite of the grub of the Japanese beetle, stings its victim so many times before egg-laying that the latter dies through mere mechanical injury.

Usually some distortion or change of colouration of the host occurs sooner or later after parasitisation. Psyllid nymphs, as a rule, when parasitised by encyrtids turn brown and become bloated. Many aphids, *e.g.*, *Aphis rumicis*, when parasitised by species of *Pachyneuron* and other chalcidoids, turn black. The effects of parasitisation of several hymenopterous and homopterous genera by stylops are now well known and in many cases are so characteristic as to be known by the special name of 'stylopisation'. In the bee genus *Andrena* some curious results follow parasitisation by the female stylops. The 'stylopised' bee has a more globular abdomen and a shorter

head: in addition certain secondary sexual characters are also affected. The parasitised female bees have the pollen collecting apparatus so reduced that their hind legs resemble those of the males, the sting is shortened in size and often the yellow colouration of the male is acquired. In the male the copulatory apparatus suffers atrophy. Indeed in *Andrena* the changes due to 'stylopisation' have been regarded not merely degenerative but as inversions of development in which the female acquires certain characters of the male and *vice versa*.

Several cases are on record in which the rate of development of a host insect is accelerated by the presence of a parasite 'Stylopised' insects of several species of *Andrena* (*A. crawfordi*, Pierce, 1909; *A. wilkella*, Perkins, 1918) were shown to emerge earlier than the healthy bees. According to Alston (1920) the larvæ of the blow-fly, *Calliphora erythrocephala*, were stimulated to immediate pupation if attacked by the braconid, *Alysia manducator*. The larvæ of a chloropid fly, *Lipara lucens* Meigen, which are full grown in autumn, normally hibernate in winter and pupate in the following May but pupation may ensue in autumn if the larvæ are parasitised by the braconid, *Polemon liparæ* Giraud (Varley and Butler, 1933). In a general discussion of this phenomenon the authors conclude that the effect of parasitisation in such cases is to provide a shock which can be and has been simulated mechanically and in nature with very much the same results.

The above instances have dealt with the effect of parasites on their hosts. Recently Salt (1937) has recorded the case of a host affecting its parasite. The eggs of *Sialis lutaria* (Neuroptera) are parasitised by *Trichogramma semblidis*, the males of which occur in two forms, both of which are equally large but differ in important characters and are not connected by intermediates. Rearing experiments with four different hosts, including the original one, showed that males bred from the original host were of apterous form while those reared from the other three (all moths) were of winged form. According to the author the dimorphism has a nutritional basis but it is not the amount but the kind of food that produces the difference. Here, therefore, it is the host that determines the character of the emerging parasite.

## Hyperparasitism

Primary parasites are about as liable to parasitisation by their insect enemies as the hosts they themselves attack but while secondary parasitism is quite common parasitism of a higher order, tertiary, quaternary, etc., is progressively rare. It seems that sometimes insects come to attack primary parasites but alight upon a secondary parasite and find themselves actually in the role of a tertiary parasite. It is also doubtful if some cases of tertiary parasitism are not merely cases of multiple parasitism in which several parasites try to live in the same host. In this struggle some of the parasites are naturally killed and the survivors, though they themselves are not directly responsible for the deaths, get the appearance of secondary parasites. The prevalence of this competitive parasitism creates considerable confusion in the determination of the exact status of a parasite, a matter of great significance in the biological control of insect pests.

The extent of hyperparasitism, a term which may include all grades of parasitism higher than primary, though some authors restrict it only to secondary parasitism, in nature depends largely upon the degree and the period of exposure or concealment chiefly of the primary parasites, specially in the cocoon stage. In general hyperparasites are not as discriminating in the selection of their hosts as primary parasites and this fact accounts for the great abundance of hyperparasitism in the field. Thus even one species, *Perilampus hyalinus*, may parasitise hosts belonging to groups Tachinidæ, Braconidæ, Ichneumonidæ, and Chalcidoidea.

## Conclusion

The problems of parasitism in insects are important in relation to several branches of natural history and in applied entomology. Their study sometimes leads to interesting conclusions about the phylogeny of host insects. Similar parasites, at present, attacking very divergent groups of insects are taken, along with other evidence, to denote a common ancestry for the latter. Questions of multiple and hyperparasitism furnish interesting material for the study of insect

populations while the interrelationships between hosts and parasites provide valuable aid in the understanding of insect behaviour. In protecting crops and domestic animals from their pests, both insect and weed, the method of controlling the latter by means of their natural enemies is coming to the fore every day but the very complex problems involved make it essential to study and thoroughly understand the parasite in relation to its hosts and environments. Few groups of insects seem destined to be more important than those collectively grouped as parasites.

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## Nicotine and Citric Acid Content in the Progeny of the Allopolyploid Hybrid *Nicotiana rustica* L. × *N. glauca* Grah.

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ALLOPOLYPLOID di-*rustica*—di-*glauca* originated by chromosome duplication in the first generation of the hybrid *Nicotiana rustica* ($n = 24$) × *N. glauca* ($n = 12$).[1] It had 72 somatic chromosomes and was partially fertile and dwarf in size, while the $F_1$-hybrid developed normally and was self-sterile.[1] In studying the procedure of the meiotic processes in the allopolyploid di-*rustica*—di-*glauca* hybrid, I found quite often the appearance of multivalent chromosomes (quadrivalents and trivalents with univalents) during the first meiosis due to auto- and allosyndesis. I shall mention here that allosyndesis between *glauca* and *rustica* chromosomes was also observed in the $F_1$-hybrids which formed a variable number of bivalents (sometimes until 12), some of them being heteromorphic. The appearance of univalents and rarely one bivalent in *N. rustica* ($n = 24$) haploid[2] indicates that bivalents in $F_1$-*rustica* × *glauca* result from allosyndetic pairing, i.e., from chiasma formation between *N. rustica* (r) and *N. glauca* (g) chromosomes.

Allo- and autosyndetic chiasmata (r—r—g—g) of the multivalents formed among *N. glauca* and *N. rustica* chromosomes in the allopolyploid di-*rustica*—di-*glauca* are responsible for the formation of unequal gametes. The inconsistency, i.e., the segregations in the subsequent generations of this allopolyploid is consequently due to the exchange of parts between *N. rustica* and *N. glauca* chromosomes in the multivalent groups as it was clearly shown for the allopolyploid *N. glauca—Langsdorffii*.[3]

The progeny of the dwarf allopolyploid *N. rustica-glauca* differed enormously in respect to their morphological, physiological and biochemical characters. In the second, third and fourth allopolyploid generation ($A_2$, $A_3$, $A_4$) there were dwarfs (about 40 cm.), giants (about 250 cm.), and all transitional degrees between these two extremes. Similar amplitudes of variations were observed in the leaf sizes and shapes, the flower sizes and shapes and the vegetation periods, the latter and the length of the petioles showing even a transgressive segregation in respect to those of the parental forms. There were segregates that developed very rapidly and formed a larger amount of green mass (leaves and stems), than the parental species *N. glauca* and *N. rustica*. A more detailed description of their morphology and cytogenetic behaviour will be given elsewhere. I shall call attention here to the alkaloid and citric acid

content of some plants of the fourth generation ($A_4$) of the allopolyploid di-*rustica*—di-*glauca*, grown in 1937.†

The data given in Table I show that the original species *N. rustica* contains alkaloid, nicotine, while the other parental species both alkaloids, nicotine and anabasine. The studies by the collaborators of the Tobacco Institute[4] showed that in species crosses when one of them has nicotine, and the other anabasine, $F_1$-hybrids contain—as a rule—anabasine. The behaviour of the

TABLE 1

*Alkaloid and citric acid contents of the amphidiploid,* Nicotiana rustica × N. glauca *and of the original species*

| No. | Plants | Alkaloid content: per cent. | | | Citric acid content per cent. |
|---|---|---|---|---|---|
| | | Nicotine | Anabasine | Total alkaloid content per cent. | |
| 1 | *Nicotiana rustica* | 2·059 | 0 | 2·059 | 5·595 |
| 2 | *Nicotiana glauca* | 0 | 0·837 | 0·837 | 3·036 |
| | Amphidiploid plants | | | | |
| | *N. rustica* × *N. glauca* | | | | |
| 3 | 75006 — 1 | 0 | 1·423 | 1·423 | 2·428 |
| 4 | 75006 — 100 | 0 | 1·232 | 1·232 | —* |
| 5 | 75006 — 101 | — | — | — | 4·967 |
| 6 | 75006 — 102 | — | — | — | 3·025 |
| 7 | 75006 — 103 | 0 | 0·971 | 0·971 | 4·679 |
| 8 | 75006 — 104 | 0 | 1·449 | 1·449 | 3·263 |
| 9 | 75006 — 105 | 0 | 1·182 | 1·182 | 4·397 |
| 10 | 75006 — 106 | 0 | 1·088 | 1·088 | 3·572 |
| 11 | 75006 — 107 | 0 | 1·395 | 1·395 | 4·447 |
| 12 | 75006 — 108 | 0·093 | 0·509 | 0·602 | 2·937 |
| 13 | 75006 — 109 | 0 | 0·753 | 0·753 | 3·431 |
| 14 | 75006 — 111 | 0 | 1·204 | 1·204 | 3·529 |
| 15 | 75006 — A | 0 | 1·386 | 1·386 | 1·319 |
| 16 | 75006 — B | 0 | 1·986 | 1·986 | 1·675 |
| 17 | 75006 — E | — | — | — | 2·081 |

* — Denotes undetermined.

*N. glauca* and all allopolyploids contain alkaloid anabasine with a single exception, namely plant No. 75006–108, which contains

† The determination of the citric acid and alkaloid contents were carried out in the Biochemical Laboratory of the Institute of Genetics under the direction of Prof. A. A. Schmuck for whom I wish to express my gratitude.

progeny of our allopolyploid confirms this rule. In crossing $F_1$ – *N. rustica* × *N. glauca* back to *N. rustica* and selfing the back crosses I obtained very abundant material which was given to N. I. Zhukov for further study. I grew in 1937 a few families of it and the results of the chemical analysis of

some plants are given in Table II. The data show that they contain both alkaloids, nicotine and anabasine. Large number of analyses carried out by Zhukov (in the press and unpublished) upon the same material during two generations showed that plants having anabasine segregate into (1) plants with anabasine and (2) plants with both anabasine and nicotine, while plants having both anabasine and nicotine never give rise to plants only with anabasine. Such a behaviour of the alkaloids suggests that the allopolyploid No. 75006—108 is a segregate resulting from crossing-over between *glauca* and *rustica* chromosomes carrying the gene or genes that are involved in the formation of the alkaloids. This question will be thoroughly discussed elsewhere.

A *N. rustica*-like segregate from the back cross (*N. rustica* × *N. glauca*) × *N. rustica* contained only anabasine without nicotine. *This is a case when biochemical character is transmitted from one species on the background of another one following interspecific hybridization.*

In studying the citric acid content (the plants contain it in form of salts) in the allopolyploid segregates (Table I) it was found that they have very different contents of this substance, although they grew under identical environmental conditions together with the parental species. Segregate No. 75006-A had, for example, 1·319 per cent. citric acid, segregate No. 75006—101 had 4·967 per cent., while the parental forms had, *N. rustica* 5·595 per cent. and *N. glauca* 3·036 per cent.

Allopolyploid *N. rustica-glauca* is an interesting plant from the agricultural point of view, because it segregates forms with larger amount of anabasine (1·986, 1·446, 1·395 per cent., etc.) than the parental species *N. glauca* which, when grown in the same environmental conditions, contained only 0·837 per cent. At the same time the offsprings contain a relatively large amount of citric acid. Further generations of some of the offsprings should give the possibility of selecting forms with larger content of anabasine and citric acid. The populations produced from the back-crosses can be used for the same purpose. It should be also mentioned here that anabasine content can be increased about three times after decapitation as the analysis by Zhukov has shown.

Alkaloid anabasine is one of the most important insecticides. It is being produced now from the *Anabasis aphylla* which grows wild. This plant contains about 1·3–2·0 per cent. anabasine. Young parts of the plant contain up to 2·53 per cent. anabasine, but the production of anabasine from *A. aphylla* is insufficient to cover the requirements of this chemical. Some of the allopolyploid segregates, on the other hand,

TABLE II

*Alkaloid and citric acid contents in some plants of the* $F_{3/4}$ *generation of the back-cross* (N. rustica × N. glauca) × N. rustica

| No. | $F_{3/4}$ of the back-cross (*N. rustica* × *glauca*) × *N. rustica* | Nicotine per cent. | Anabasine per cent. | Total alkaloid content per cent. | Citric acid per cent. |
|---|---|---|---|---|---|
| 1 | 75115 — 1 | 0·927 | 0·403 | 1·330 | —* |
| 2 | 75133 c — 2 | — | — | — | 2·554 |
| 3 | 75133 c — 3 | 0·654 | 0·648 | 1·302 | 4·856 |
| 4 | 75133 c — 5 | 1·140 | 0·502 | 1·642 | 5·118 |
| 5 | 75133 c — 6 | 0·645 | 0·718 | 1·363 | — |
| 6 | 75134 c — 1 | — | — | — | 3·964 |
| 7 | *Nicotiana glauca* | 0 | 0·837 | 0·837 | 3·036 |
| 8 | *Nicotana rustica* | 2·059 | 0 | 2·059 | 5·595 |

* — denotes undetermined.

grow very rapidly and give a very large amount of green mass when grown in suitable environmental conditions.

Considering all these facts, I think that our allopolyploid *N. rustica—N. glauca*, as well as the back-crosses and other hybrids between *N. rustica* and *N. glauca* that are studied now in the All-Union Tobacco Institute by N. I. Zhukov might answer the demands of the industry in a short time if the plant-breeding work with these plants is put on a somewhat larger scale.

I shall also mention here that most of the allopolyploid segregates are from perennial plants like *N. glauca*, and the annual parent, *N. rustica*. In autumn 1938, when the temperature dropped at night to −5° C., the leaves of *N. glauca* were severely injured, but the plants were not killed. The same reaction occurred with most of the allopolyploid segregates. A few segregates were, however, less injured than *N. glauca* plant. A single segregate was not affected by −5° C. All *N. rustica* plants were killed by a temperature of −3° C. Amphidiploids *N. rustica* × *tabacum* and *N. glauca* × *Langsdorffii* behaved in a similar way. Autotetraploid plants of *Solanum Lycopersicum* were also more resistant to cold than their diploid forms. Preliminary observations show that a series of polyploid plants are more cold-resistant than their original diploids. This new character permits the polyploid forms to occupy more nordic areas than their original diploids. It seems very probable that polyploidy will help the plant breeders to move some of the existing cultivated varieties and even some forest plants towards more nordic regions by doubling their chromosome numbers.

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[3] Kostoff, D., *Journ. Genet.*, 1938 (in the press).

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## OBITUARY

### Ravindra Nath Misra (1912–38)

ON the 9th of December 1938, a tragic accident removed from our midst Ravindra Nath Misra, Research Fellow in Botany in the University of Lucknow. Mr. Misra died of burns received by the bursting on him of a flask of alcohol which caught fire while he was trying to light a spirit lamp. He passed away very young, when he was hardly twenty-six and was beginning to carve out for himself a brilliant career in botanical research. Only a few days before his death he was awarded the *Ruchi Ram Sahni Prize* for 1938 for the best research work in Botany.

Ravindra Nath Misra

Mr. Misra became Research Scholar on obtaining his M.Sc. degree in 1936. By himself and in collaboration with Dr. S. K. Pande, he carried out investigations on the liver-worts of this country. He was collaborating with Dr. Pande in the production of a series of monographs—"Studies in Indian Hepaticæ".

Mr. Misra had a tremendous love for mountaineering. He organised several expeditions from the Botany Department of the Lucknow University to far off places in the Himalayas and brought back with him valuable plant collections.

It is difficult to believe that a promising career like his could be cut short so cruelly and with such gasping suddenness. As a man, he had rare qualities: frank, straightforward and untouched by mannerisms. His is a loss to Indian Botany, not only on account of what he could achieve during his butterfly existence, but also because of what he would have achieved if he had been spared. Among his friends he has left a void which cannot easily be filled.

RAJENDRA VARMA SITHOLEY.

# REVIEWS

**Theoretical Hydrodynamics.** By L. M. Milne-Thomson. (MacMillan, Ltd., London), 1938. Pp. 552 + xxii. Price 31*sh.* 6*d.*

Text-books on hydrodynamics are none too common and the appearance of a new one is to be heartily welcomed. The object of the present book, as stated in the Preface, is "to give a thorough, clear and methodical introductory exposition of the mathematical theory of fluid motion which will be useful in applications to both hydrodynamics and aerodynamics". In reviewing a book of this kind one is led naturally to compare it with the only other English text-book on the subject, Ramsey's well-known *Hydromechanics*, Part II, which has served successive generations of students for over quarter of a century. The range covered by both the books is very nearly the same. Apart from differences in the treatment of individual topics, the main point of difference consists in the consistent use of vector methods, which was deliberately avoided in the older text-book. In the present book, after an introductory chapter devoted to the Bernoulli equation and its applications, vectors are introduced and explained in the second chapter and the leading formulæ of vector analysis are developed. The treatment of two-dimensional problems requires the use of the theory of analytic functions and conformal transformations, to which, therefore, is devoted a separate chapter. Next follow seven chapters devoted to the application of conformal mapping to a variety of problems of two-dimensional fluid motion covering standard topics such as sources, sinks and images, flow past cylinders, the theorems of Blasius and of Kutta-Joukowski, the impact of a stream on a lamina and also a few others. Of these latter, special mention may be made of the account of the elementary theory of the aerofoil (which gets a chapter for itself), the extended form of Blasius' theorem, various cases of impinging jets and an account of Levi-Civita's general method of determining the flow past an obstacle, including a derivation of Levi-Civita's elegant expressions for the drag and lift. The remaining chapters devoted to vortex motion, waves, the motion of solids in liquids, etc., need no separate mention. The concluding chapter on viscosity includes brief discussions of Prandtl's hypothesis of the boundary layer and Oseen's linearised equations for slow motions. The value of the book is considerably enhanced by the relatively large number of diagrams illustrating the disposition of the streamlines in the various problems and more especially by the beautiful and striking photographs illustrating the formation of vortices in the motion of an aerofoil and of the Karman trail. Following the best English tradition, large collections of examples are given at the ends of the chapters and should be of invaluable aid both to the student seeking to become a past-master in the tricks of the trade as well as to the examiner hunting for fresh traps to catch the inexpert and the unwary. Of course, the collections naturally include also many problems of greater intrinsic importance. A very short historical sketch, in the form of a list of the leading names (with dates) associated with the progress of the subject, is given at the beginning of the book. It is not a little surprising to find that no mention is here made of Lord Kelvin, whose remarkable researches have contributed so largely to the development of the subject.

As already stated, vector methods are used throughout. It is largely a matter of individual taste what notation one prefers and it is no doubt true that the vector notation contributes to economy in the writing of formulæ, but the author's claim that it "simplifies and illumines" the whole subject seems to the reviewer to be a little exaggerated. Vector analysis is more adapted to give neat general formulæ than to the working out of individual problems; indeed the author has himself remarked (p. 39): "as soon as a problem becomes sufficiently particularised to yield numerical results, it will be found that recourse to co-ordinates will be advisable." The trouble is that in hydrodynamics, we are nearly always interested in such particular problems and relatively rarely in general theory, unlike in electro-magnetic theory for instance, where we have a large body of general theory to which the vector method contributes both elegance and simplicity.

This review began with a comparison of the present text-book with another and it

is, perhaps, not inappropriate that it should conclude by referring to a last point of difference between them, namely, the difference in price. The rather high price of the present book must inevitably make it inaccessible to many and prevent a good text-book from being used as widely as it deserves to be. K. S. K. IYENGAR.

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**Advanced Analytic Geometry.** By Alan D. Campbell. (John Wiley & Sons, New York; Chapman & Hall, Ltd., London), 1938. Pp. x + 310. Price 20*sh.*

The object of this book is to give an analytical presentation of projective plane geometry. It is divided into two parts, Affine and General Geometry, treated in the first eight and the last ten chapters respectively.

The first six chapters deal mostly with some of the tools of affine analytic projective geometry, *e.g.*, frames of reference, affine linear transformation of co-ordinates, groups of linear transformations and their associated geometries, and imaginary elements in geometry, *viz.*, points, lines and curves at infinity. The seventh and eighth chapters consider the geometric material on which these tools are used, *viz.*, conics, systems of conics and *n*th degree curves.

The second part gives an introduction to the general projective plane geometry. The triangle of reference and homogeneous co-ordinates are studied in detail. The line at infinity is used to discuss various types of conics. Homogeneous and non-homogeneous line-co-ordinates are defined and applied to conics and other *n*-ics. Plane duality has been studied both from the synthetic and analytic standpoints. There is a lengthy chapter on general projective transformations in point- and line-co-ordinates, which are then applied to discuss the collineations, homologies, elations, projectivities, involutions, cross-ratio, harmonic ranges and pencils, correlations and poles and polars. The last four chapters deal with some projective properties of conics, complete quadrangles, *n*-ics and linear families of conics.

The book is profusely illustrated, and contains examples and exercises after each section. Matrices and determinants are used freely, and the style itself is very terse. This has made it possible for the author to compass a large amount of material within 300 pages. The reference system is rather defective. The equations are numbered from 1 to 138, and there is no indication of the section or chapter at the head of the pages, so that one has to waste a lot of time in finding a particular equation to which reference is made in the text.

The book would serve as an excellent introduction to analytical projective geometry, and is to be strongly recommended.

M. R. S.

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**Co-ordinate Solid Geometry.** By Robert J. T. Bell. (Macmillan & Co., London), 1938. Pp. xiii + 175 + xliii. Price 7*sh.* 6*d.*

Professor Bell's *Elementary Treatise on Co-ordinate Geometry of Three Dimensions* has been the popular text-book on the subject in Indian and British Universities. The book under review is a reprint of the first nine chapters of the older book, and provides an introductory course on the plane, straight line, and the standard conicoids. Professor Bell has taken advantage of this opportunity to make some improvements, and has added an Appendix giving simplified methods for the distance from a point to a plane, constants in the equation of a line leading to line co-ordinates, section of a surface by a given plane, cone with a given curve as base, generators of the hyperboloid and reduction of the general equation of the second degree. The inclusion of more miscellaneous examples has enhanced the utility of the book.

In the opinion of the reviewer, the chapter on the Sphere is too brief. It could profitably have contained an account of the polar planes and lines, locus of parallel chords, etc., leading on to the corresponding account for the conicoids. The cylinder also should not have been altogether neglected.

However, the book is admirably suited for beginners, and would be welcome to students and teachers alike. The price seems to be rather too high for a book of this kind. M. R. S.

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**A Course in Chemical Spectroscopy.** By H. W. Thompson. (The Clarendon Press, Oxford), 1938. Pp. vi + 86. Price 6*sh.*

Recent rapid and significant developments in the theories of spectroscopy have made the spectroscopic method of tackling problems in science one of the most useful and important both in the pure and in the applied branches. An acquaintance, therefore,

with the principles and practice of spectroscopy, is an essential equipment for every student graduating in chemistry and physics.

This little and extremely well got-up book sets out to meet in a very elegant manner this need. In fact, it is based upon a laboratory course in chemical spectroscopy recently introduced at Oxford. Eight experiments in all, have been selected for description, three of them relating to the spectra of atoms, and the rest to the electronic-banded, absorption, and infra-red spectra of molecules. A brief account of the relevant theories is given in the beginning for each of the above experiments. In order to help those who do not possess the full laboratory facilities, photographs of spectra are included, so that problems can still be followed and the calculations made.

In the opinion of the reviewer, one more experiment on the Raman spectra ought to have been included in this book, particularly as this easily takes a rank among those of "chemical importance", a basis on which the author admits the experiments described have been chosen.

We heartily recommend this book for purchase by everybody interested. Its low price should be an additional commending feature for all Honours students in chemistry and physics. M. A. G. RAU.

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**The Amplification and Distribution of Sound.** By A. E. Greenlees. (Chapman & Hall, Ltd., London), 1938. Pp. 254. Price 10*s.* 6*d.* net.

The lay-out, maintenance and operation of sound amplifying equipment for public address systems, ball-rooms, theatres and other needs of a like nature involve a knowledge of a special branch of Radio and Electrical Engineering. Information of this nature is not always available in a single volume. Hence, this little book dealing, in a fairly comprehensive way, with the specifications and lay-out of amplifying equipment with just the necessary calculations for its proper design, is a useful addition to literature on this subject.

The book under review opens with an introductory chapter dealing with the fundamental formulæ of Electrical Engineering, with simple calculations to illustrate their practical applications.

The chapter dealing with the design of chokes and transformers used in power amplifiers, although not exhaustive, is quite adequate for all practical purposes.

The portion dealing with amplifiers could have been more elaborate. Although the author has not failed to touch on the more important systems of power amplification, one feels that a little discussion of the relative merits of different systems could have helped the practical designer to pick and choose for his individual requirements.

The details of construction and performance of different types of microphones with their individual merits for a given type of work, are quite interesting and informative.

Considering the important rôle played by building materials, and the geometry of buildings in determining the reverberation time, which has an important bearing on the clarity of amplified speech projected in a given enclosure, it is rather surprising that a book dealing with the distribution of sound should not have given more importance to this aspect. A few pages devoted to the calculation of reverberation period of halls and the coefficient of absorption of materials used in building construction should have made the book more comprehensive and complete.

The author has succeeded in making the book useful for the practical man, who will find in it sufficient material to help him in the lay-out of amplifying equipment. The get-up is of a high order, the illustrations and diagrams are clear and to the point.

C. C.

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**Vitamins and Vitamin Deficiencies.** By Dr. Leslie Harris. Vol. I. *Historical and Introductory,* Vitamin $B_1$ and Beri-Beri. (J. A. Churchill, Ltd., London), 1938. Pp. xiv + 204.

The last few years have seen rapid and fundamental advances in our knowledge about the vitamins. The chemical nature of the more important of them has been revealed, rapid and accurate chemical or physical methods of assay have been discovered, and considerable insight has been gained into their function in the animal organism. The importance of this advancing knowledge has been further enhanced by its increasing application in practical problems of health and disease. At the present time the subject has by far out-stepped the scope of the many earlier popular and semi-popular books. The books which summarised the results of scientific research in this field,

for example the monograph published by *The Medical Research Council* of Great Britain, and another by Sherman and Smith published by *The American Chemical Society*, have grown rapidly out of date. There was never more urgent need than to-day, of a detailed summing up of the knowledge acquired by modern research in this field.

The literature on this subject is exceedingly voluminous. An earlier estimate put down the output of papers during one year alone, at approximately one thousand, or about three new papers every day. This intense research activity has continued for over thirty years. While each paper represents some advance in knowledge, the evidence presented is sometimes contradictory. The task of proper co-ordination and summing up of scientific facts scattered in this vast literature, and of sifting out the essential from the non-essential, and the reliable from the unreliable, is indeed formidable. It can be performed in an adequate manner, by one who is not only deeply versed in the whole of the literature, but also has wide experience of research to be able to appraise properly the work of others.

It is highly gratifying to find that a person of Dr. Harris's wide outlook and experience in this field has undertaken this task. Dr. Harris has planned a series of seven volumes on 'Vitamins and Vitamin Deficiencies'. Volume I, which has just been published covers the Historical Introduction, Vitamin $B_1$ and Beri-Beri. The other six volumes which are also ready, and are to be published shortly, will deal with the other factors in the order in which they were investigated experimentally.

The Historical Introduction is covered by the first two chapters, which within the campus of only thirty-three pages, reviews in a comprehensive manner the intriguing story of the discovery of vitamins. This review shows evidence of intensive research and appraisement of the work of pioneers and as Sir Frederick Gowland Hopkins says in the Foreword 'it is perhaps the fairest account of the pioneer labours that has yet been written'. The other three chapters in the book are devoted to vitamin $B_1$ and vitamin $B_1$ deficiency, embracing all the different aspects of the subject—chemical, physiological as well as clinical. These chapters represent as the first two, the most comprehensive but concise summing up of the essential knowledge on the subject. Dr. Harris has the natural gift for the co-ordination of heterogeneous scientific facts of stating them clearly, correctly and yet concisely. In this work Dr. Harris has brought into play his extraordinary gift and the result is a book of exceptional value. At the end of each chapter there is a complete and up-to-date bibliography.

Dr. Harris's book will be welcomed alike by students, teachers and research workers. It is of special value to students and teachers, because within the campus of a relatively few pages a full and up-to-date knowledge of the subject is presented in a simple and lucid manner. To research workers, in this book, will be available a comprehensive synopsis of the essential facts with complete references to original literature. The other features of the book are all that can be desired. The publication of the other volumes will be looked forward to with great interest. B. AHMAD.

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**Dia- et Paramagnétisme et Structure de la Matière.** Par B. Cabrera. (Actualités Scientifiques et Industrielles, No. 562. Hermann & Cie, Paris), 1937. Pp. 76. Price 20 *fr.*

In this volume the author has briefly summarised the results of recent magnetic research in so far as it has served to elucidate the structure of matter, with special reference to the contributions of the author and his collaborators in the field. The fundamentals of the configurations of atoms and their significance in magnetic theory are dealt with in an introductory chapter and the two remaining chapters are concerned with dia- and paramagnetism respectively. After a brief outline of Langevin's theory and the law of additivity of Pascal the author has discussed in detail the constitution of water as revealed by magnetic measurements. There is also a clear account of the law of additivity as applied to the alcohols H $(CH_2)_n$ OH from which the susceptibilities of H, OH and $CH_2$ are derived. The outstanding achievement in paramagnetic theory in recent years has been the deduction of the magnetic moments of the ions of the paramagnetic elements by the application of spectroscopic theory. Although in the case of the rare earth elements fairly satisfactory agreement between theory

and experiment has been achieved, the discrepancies are considerable in the case of the iron group of elements. This aspect is discussed with the help of curves showing the variation of $\sqrt{C_m}$ as a function of Z for the various paramagnetic ions and the disagreements between theory and experiment are emphasised. The interesting properties of the palladium and platinum groups of elements and the interpretation of their feeble magnetic moments are also lucidly explained. The book is on the whole, a useful résume of some of the most important aspects of dia- and paramagnetism in relation to structure. Attention may be drawn to some minor typographical errors such as "$e^2$" *instead of* "$c^2$" in the expressions for $\vec{\mu}_a$ and $\vec{\mu}_A$ on page 15; "Bhor" for "Bohr" on page 36, line 11. P. N.

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**Essai sur l'unicité des sciences mathematiques dans leur developpment actuel.** By Albert Lautman. (Actualités Scientifiques et Industrielles, No. 589. Hermann & Cie, Paris), 1938. Pp. 58. Price 15 *fr.*

The origin of this very interesting essay is no less interesting. In the Preface to his well-known book on Quantum Mechanics, Weyl drew a distinction between two different and, according to him, opposed trends in the development of mathematics—between what may be called the "classical" and the "modern". In the first, the basic idea is that of 'number' or 'magnitude' and in the second, that of 'structure' and 'form'. Under the former may be included practically the whole of nineteenth century analysis, while the modern axiomatic theories come properly under the latter. In the book under review, the author is concerned in refuting this supposed antithesis and in showing how, in the actual development of mathematics, the two methods instead of being opposed and antithetical, have actually enriched and complemented each other in building up the mighty structure of modern mathematics. This thesis is illustrated by examples drawn from the most diversified branches of mathematics—modern algebra, integral equations, algebraic functions, differential forms, analytic functions, quantum mechanics and so on. Whether Weyl meant his statement to be taken with such uncompromising seriousness as our author does it would be difficult to say, but that need not prevent us from enjoying this delightful essay with its surprising analogies and striking illustrations. Incidentally the author displays a familiarity with every branch of mathematics—from the most recondite results in classical analysis to the latest developments in modern mathematics—which cannot but excite admiration. When the mind is jaded out with dull routine or by concentration on specialised problems, one would wish for no better diversion than these refreshing pages.

V. R. T.

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**The Health of the Nation and Deficiency Diseases.** By John Maberly. (Bailliere Tindall & Cox, London), 1938. Pp. xi + 118. Price 5*sh.*

This is an addition to the already long list of books on nutrition written for the general public. Unfortunately the author's accuracy and scientific judgment are not equal to his enthusiasm. Numerous errors and misstatements detract greatly from its value.

R. P.

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**Interpretations and Misinterpretations of Modren Physics.** By Philipp Frank. (Actualités Scientifiques et Industrielles, No. 587. Hermann et Cie, Paris), 1938. Pp. 59. Price 18 *fr.*

This is an acute and penetrating analysis of the manner in which statements of the results of modern physical research are couched in such terms as lead to philosophical conclusions utterly unwarranted and unwarrantable by Physical Science. The author shows that such attempts to support pet philosophical systems by Physical Science have always been ready to make use of any vaguely apprehended scientific statements to further their own object, and successfully proves that many conclusions about questions of Fatalism or Free Will contained chiefly in popular presentations of modern Physics are based entirely on a wrong philosophical interpretation of physical theories vaguely formulated so as to contain terms susceptible to such misinterpretation. As a corrective to the biassed opinion one may form of modern science by reading such popular works (including those of Sir James Jeans) we have no hesitation in recommending the present brôchure to the attention of every thinking man who wants to have a just conception of the part to be played by physical science in shaping his attitude to the problems of life. T. S. S.

# The Botany of Field Crops*

THE study of botany is an ancient and agreeable pursuit. Wild flora were usually the centre of attention. Nature study, especially in school gardens, has rarely meant the study of the botany of familiar crops. Familiarity in this respect, as in many others, bred contempt. In horticulture the artistic impulse corrected this trend. There are sound monographs on roses, chrysanthemums, orchids and other horticultural plants. It was not till after the Great War that the value of agriculture as a science and the part that knowledge played in its improvement, were recognised. There was no time nor the necessary temperament to wait for the old age-long method of hit, miss and learn. A systematic attack was indicated as a necessity. European powers with an interest in colonial possessions strengthened their agricultural staff and there followed a world-wide awakening of interest in crops. It was otherwise with America where a modern nation was on virgin land and all experience had to be and was gained anew. The interest in crops was a live issue there, much earlier than in the Old World, that grew old in the learning of this knowledge. The first interests were on industrial crops and of these cotton figured most; it might be said to-day that cotton is the crop about which there is the greatest information. The awakening of "Native" populations and the need on the part of the settlers and conquerors to bear in mind the health and welfare of these populations with whose contentment and prosperity their welfare is bound up, broad-based the interest in crops, with the result that to-day practically on every crop, be it food or industrial, there is an endeavour to clear the ignorance concerning it. Agricultural Colleges and Institutions have sprung up in large numbers and almost every Agricultural Department of importance has an Economic Botanist in its staff. Work in Economic Botany has ramified so much that there are specialists on important crops or groups of crops.

Concurrent with this advance there has been great progress in the science of genetics. The plant world has provided handy material for the pursuit of its laws, and crops have naturally come in for their share of attention and utilization.

The ultimate result of this general interest is that during the last two decades there has been an enormous output of literature on various aspects of crop improvement. Many of these are bits of crisp information, but few of them have reached the stage of being epitomes of general knowledge in the realm of crops. In the category of single-crop knowledge will rank such publications as those of Percival on Wheat, Balls on Cotton, Copeland and Ramiah on Rice, Salaman on Potato, Barber and Earle on Sugarcane, and Copeland and Sampson on Coconut. On groups of plants there are well-known publications like those of Tanaka on Oranges, Kirtikar and Basu on Medicinal Plants, and Blatter, Hitchcock and Arber on Grasses. Recently, elaborate and well-illustrated monographs have come out and of these, Ochse's "Vegetables of the Dutch Indies", and the special publications of the New York Agricultural Experiment Station on the vegetables of New York deserve special mention. Even Kew, the stronghold of orthodox botany, has recently added an Economic Botanist to its staff and has issued a special Bulletin of Miscellaneous Information in 1936 on the Crop Plants of the British Empire. It began its specialisation in crop plants with Snowden's Classification of Cultivated Sorghums. In the complementary portion of this work, namely, the knowledge of the varieties as crops alive, the Millets Breeding Station at Coimbatore with its world-wide collection of sorghum is playing its part. Kew has next taken on hand work on cowpeas and has realised the value of live material in the elucidation of facts not entirely in the ken of herbarium specimens. The various cowpeas are being grown on typical Empire Stations so that the knowledge and understanding obtained and the basis for their classification may be full and sound.

The results of these many endeavours along many lines and on many crops all over the world have not been focussed within the limits of a single publication except

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* *Introduction to the Botany of Field Crops*, by J. M. Hector, Professor of Agricultural Botany, University of Pretoria. 2 Volumes. (Central News Agency, Ltd., Johannesburg, S. Africa), 1938. Pp. lxxvii + 1127. Price £3 10*s*. nett. per set.

in the well-known book of Robbins on *The Botany of Crop Plants*. Since Robbins wrote his book, there has been a tremendous accession to our knowledge and it is therefore very gratifying to be able to receive and review the two sumptuous volumes on *Introduction to the Botany of Field Crops* by J. M. Hector, Professor of Agricultural Botany in the University of Pretoria. It is particularly gratifying to us in India that this South African publication has devoted itself so intensively to a wide range of crops, of interest not only to Europe and America, but to Asia and Africa also. None but a professor could have the leisure and comprehension to bring together this scattered knowledge into a single publication and South Africa is a particularly eminent place from which to survey the crops of the East and the West. One of the chief sources with the help of which this gathering together was achieved is obviously the *Plant Breeding Abstracts*, a precious publication of up-to-date knowledge on crops, both Empire and foreign, the prompt publication of which we owe to the vigilance and enterprise of the Imperial Bureau of Plant Breeding and Genetics, Cambridge.

Mr. Hector is very right in his view that in dealing with crops he considered them as dynamic, and any gathering of knowledge on them tentative. This will be obvious to any worker on crops; the more intimate the contact, the greater are the revelations. There is no palling or ultimateness in this experience. One is almost tempted to say that there are always surprises in store. As with Kipling's Mason and his Palace, "The *end* is forbidden". All that a worker can say is "I too have known".

Mr. Hector has rightly utilised the extensive genetical knowledge with restraint. The place assigned to cytological approach is consistent with its present advance and rapid growth. The physiological knowledge is far from advanced and is rightly not given undue importance. The nebulous intelligence which, for want of precision in pursuit, is summarised and dismissed with the familiar words "soil and climatic conditions" awaits critical analysis and this aspect is rightly left out. In the realm of Economic Botany, the chief work at present is the reconciliation of genetics and cytology to taxonomy, and of the latter, to a rational and practical system of varietal classification. The student will be much nearer having the equipment for this task after a perusal of these volumes. In dealing with particular crops, the latest knowledge regarding them has been incorporated. Even such recent advances in the study of crops as photo-periodism, vernalisation and cyto-generic crosses, have been dealt with. There is a good Bibliography for each chapter and a comprehensive Index. A special word has to be said on the choice and fineness of the illustrations which enhance not a little the utility of the publication. In these two volumes, one on cereals and the other on non-cereals, one has a wealth of information on almost all aspects of Agricultural and General Botany with special reference to readily available common crops. Mr. Hector has done a service to all students of Agricultural Botany. These books will also prove very valuable to a wide range of workers in the botanical field and should find a place among standard books on Botany. They will prove an eye-opener to the wealth of wonder that could be obtained on things common. The volumes under review are a precious addition to the very valuable series of monographs that have figured in the South African Agricultural Series. The publishers, The Central News Agency, Ltd., Johannesburg, South Africa, are to be complimented on the excellent get-up and fine finish of the volumes.

G. N. R.

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# LETTERS TO THE EDITOR



## Molecular Association in Mixtures of Acetic Acid and Acetone

IN a recent publication,[1] the author reported the effect of water on the molecular constitution of acetic acid and attributed the shift of the Raman line of the C = O group of the acid towards longer frequencies at higher dilutions to a breaking up of the associated molecules into simpler ones in solution. There was no direct evidence for the formation of hydrates since such a hydration must lead to a shift towards shorter frequencies as in the case of mixtures of acetone and water in which a shift of the C = O band towards smaller frequencies was observed.[2]

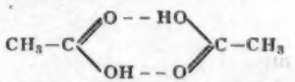
As an extension of the above work with a mixture of an associated polar liquid with another associated polar liquid, it was considered desirable to study the effect of a normal polar liquid like acetone on an associated polar liquid like acetic acid.

The C = O Raman band of pure acetic acid is a broad one with an intensity maximum at 1670 and with very feeble components at 1710, 1760. On mixing with acetone, the intensity maximum of this band shifts towards longer frequencies as in the case of dilution in water. The C – C line of acetic acid has $\Delta\nu = 893$ with a feeble component at 872 in the pure state. But in the solution in acetone, the feeble component gets more intense till it is comparable to its stronger companion and both the lines shift to smaller frequencies.

The effect of acetic acid on acetone is complimentary. As in the case of mixtures of acetone in water, methyl alcohol, and phenol,[2] the 1710 C = O line of acetone gets shifted to shorter frequencies till it gets blended with the shifted band of acetic acid, and the C – C line of acetone $\Delta\nu = 790$ shifts to longer frequencies.

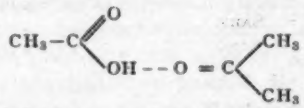
A new line at about 1760 which is not at all prominent in either of the liquids, though it is present as a very feeble component in pure acetic acid attributable to its monomer, makes its appearance in the mixtures of acetic acid and acetone. Its intensity is maximum in a 50 : 50 solution by volume while at other concentrations it persists, though with a diminished intensity.

For an explanation of these results, a consideration of the molecular constitution of these liquids in the pure state is necessary. Pure acetic acid is well known to exist in the dimeric form of the type



at ordinary temperatures, the dotted lines representing the "hydrogen bonds", or the coordination linkages between the 'donor' O in C = O and the 'acceptor' H in OH. Pure acetone is a normal liquid existing in its

monomeric form but the O in its C = O has strong donor properties. In the mixture of the two liquids, the shifting of the acetic acid C = O line to higher frequencies and its C – C to shorter frequencies indicates the breaking up of the associated molecules, while the shifting of the acetone C = O line to lower frequencies and its C – C line to higher frequencies indicates an association of the acetone molecule with that of the acid forming probably a complex of the form



The line 1760 may probably be due to the un-co-ordinated C = O set up in the complex so formed. The percentage of such complexes is largest in a 50 : 50 mixture and hence the increased intensity of this line at that proportion as compared to other concentrations.

On a comparison of these results with those in aqueous solutions of acetic acid, it is clear that both water and acetone have strong dissociating power on the acid molecules. But whereas, in water, its influence seems to be mainly to break up the molecules without an appreciable tendency to associate with the molecules so broken up, in acetone, there is a definite evidence for the association of the monomeric acid molecules liberated and the acetone molecules. The explanation of the differential behaviour of the two liquids lies probably in the fact that though both of them are polar, and have donor atoms, water is highly associated while the latter is not. In mixtures of associated liquids the influence seems to be a mutual dissociation of both.

The author's thanks are due to Dr. I. Ramakrishna Rao for his helpful guidance.

P. Koteswaram.

Andhra University,
Waltair,
*February* 1, 1939.

[1] *Z. fur. Physik.*, 1938, 110, 118.

[2] Unpublished work of the author.

## Distribution of Temperature and Humidity in the Upper Air over Karachi

The kite flights made by J. H. Field in August and September 1905, were the first attempts to determine the temperature and humidity conditions in the upper air over Karachi. Although the flights were made on only 14 days and the highest flight reached 1,380 metres, valuable information was obtained[1] regarding the conditions in August and September, the chief feature discovered being, the existence of a well-marked inversion separating a lower layer of moist sea air from comparatively very dry air above.

Since June 1927, the R.A.F. at Karachi (Drigh Road) have taken observations of dry and wet bulb temperature and pressure at definite altimeter heights on aeroplane flights and provided meteorological information of great value. The data obtained after January 1929, have been published in the 'Upper Air Data' volumes of the India Meteorological Department. The published data of the seven years, 1929–35, have been recently analysed and discussed in *Indian Meteorological Department Scientific Notes*,[2] in which diagrams showing the average distribution of temperature and humidity during the year up to 3 Kms. (or about 10,000 feet) have been given. These diagrams were prepared from the mean values of data tabulated for every ½ Km. height and do not show quite clearly certain peculiarities of the temperature and humidity distribution below 6,000 feet. With a view to bring out more clearly these peculiarities and also to extend the diagrams to 5 Kms. (or about 16,000 feet) up to which height, the aeroplane meteorological flights extended after January 1936, new diagrams have been drawn (Figs. 1 and 2) based on the data for 1936 and 1937, utilising temperature and humidity values tabulated for every 0·25 Km. height.

The temperature diagram (Fig. 1) shows isotherms drawn at intervals of 4° F. and the humidity diagram (Fig. 2) shows lines of equal relative humidity drawn at intervals of 10 per cent. relative humidity. The average heights of base of inversion (dash and dot line) and

of top of inversion (dash and two dots line) during April to September are also shown in the temperature diagram. An examination of

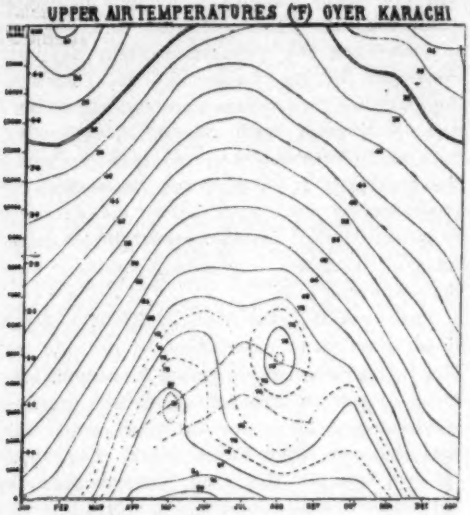



FIG. 1

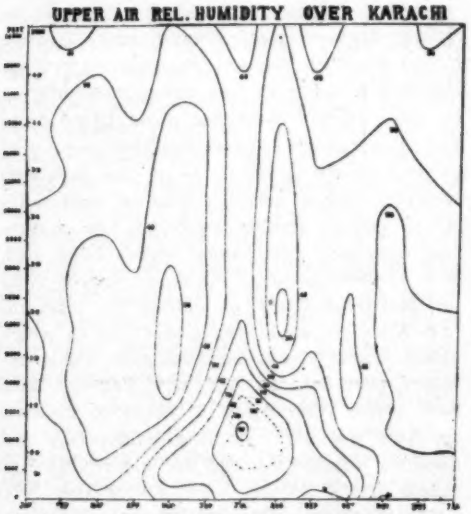



FIG. 2

the diagrams reveals some important features which are mentioned below.

(i) The 32° F. isotherm (double line) shows that the freezing temperature occurs at a height of 12,000 to 13,000 feet in the winter months—December to March—and at higher levels in the rest of the year. It occurs at heights of over 16,000 feet in June to September. The above information is of interest in connection with the question of ice-formation on aeroplanes. Ice-formation is known to occur in regions where the temperature is below the freezing point of water and the air saturated with water in the liquid state as in clouds or rain. At the heights at which freezing temperature (or lower temperature) occurs over Karachi the air is generally only about half saturated, so that in general, ice-formation does not appear to be a serious problem for consideration for flights over Karachi; at any rate not for ordinary flights which are confined to a height of 10,000 feet. Ice-formation on the wind screen was experienced at 13 to 14 thousand feet by planes flying over Karachi in thick alto-stratus cloud on 17th December 1937. The temperature at that height was 22 to 25° F.

(ii) The temperature distribution as shown by the general run and spacing of the isotherms indicates that between 1,000 and 3,000 feet in April and May, and between 2,000 and 5,000 feet in June to September, inversions, isothermal regions and regions of low lapse rate of temperature are common, specially during June to September. The results of individual aeroplane flights also show that inversions occur during May to September, being most frequent and well marked in July and August. The closed isotherms of 74°, 76° and 78° F. indicate that inversions are very common in August. A preliminary study of the inversions over Karachi has been reported.[3] A more detailed study is being made by the authors separately.

(iii) Considering the year as a whole, there is a subsidiary maximum of temperature in October up to a height of about 3,000 feet, the main maximum being in May–June. This is due to the complete disappearance of the low clouds which are nearly always present in the day time during June–September.

(iv) The relative humidity distribution is more or less symmetrical about July which is the most humid month. The highest relative

humidity in the year occurs at a height of about 2,500 feet in July–August. This is approximately the height at which, during this period, a sheet of stratus cloud exists almost daily in the morning and evening hours near the base of an inversion marking the top of a moist layer of sea air. Above the stratus sheet or the base of inversion, there is a rapid decrease of relative humidity with height in the inversion region till the dry continental air above is reached. The closeness of the humidity isopleths between 2,000 and 5,000 feet in May to September indicates this rapid fall of relative humidity.

The lowest relative humidity in the year occurs between 4,000 and 8,000 feet in May and between 6,000 and 7,000 feet in August. In these regions, which are above the inversion, dry continental air prevails.

A detailed study of the structure of the atmosphere over Karachi taking the upper wind circulation also into consideration is in progress.

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R. A. F. Meteorological Office,
Karachi Air Port,
*January* 28, 1939.

[1] *Mem. Ind. Met. Dep.*, **20**, Part I.
[2] *Ind. Met. Dept., Sci. Notes*, **7**, No. 78.
[3] *Ibid.*, 50.

## Constitution of Iodic Acid

THAT iodic acid behaves differently from its analogues chloric and bromic acids has been known for a long time. J. Thomson,[1] Ostwald,[2] Walden,[3] Rosenheim and Liebknecht,[4] Groschuff[5], Dhar[6] and others have shown that iodic acid exists in solution in the polymerised condition, some suggesting also that the iodate ion is probably divalent. In a previous paper[7] evidences were adduced to show that a 6 N. solution of the acid contains mainly $(HIO_3)_3$ molecules while a dilute solution (below 0·1 N.) only the ions of the monobasic acid $HIO_3$, and that the iodate ion is monovalent.

The existence of the three salts, $KIO_3$, $KIO_3 \cdot HIO_3$ and $KIO_3 \cdot 2HIO_3$ suggests the existence of the three corresponding acids: $HIO_3$, $(HIO_3)_2$ and $(HIO_3)_3$.

Since a change in constitution is taking place apparently by dilution it must be of interest to find out at what concentrations, if any, such

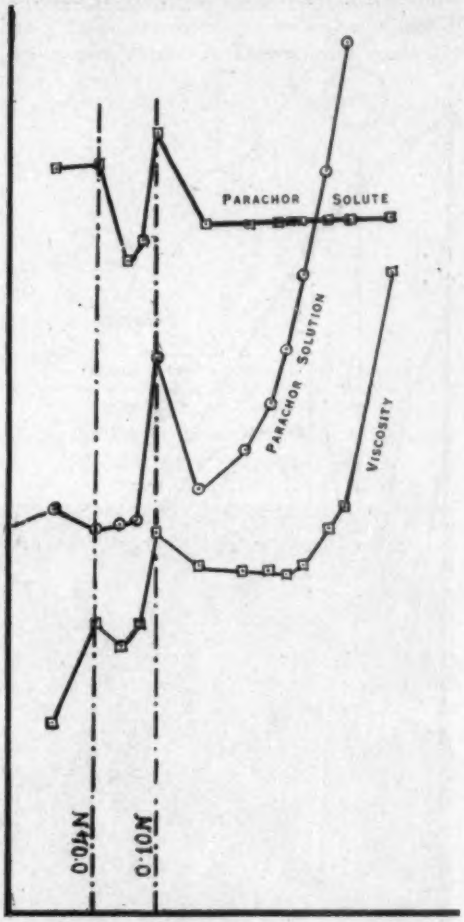


FIG. 1

changes are brought about. With this end in view a number of physical properties have been studied and graphs obtained connecting the property of the solute with the concentration. For this purpose the mixture law equation was employed:

$$P_{soln.} = (1 - x)P_{solvent} + (x)P_{solute},$$

where P denotes the property investigated, *viz.*, density, viscosity, surface tension, parachor,

refractive index, etc., and $(1-x)$ and $(x)$ the mol. fractions of the solvent and solute respectively. When $P_{solute}$ is plotted against concentration a remarkable similarity is observed in the behaviour of all the curves (Figs. 1 and 2), which show breaks at definite points, *viz.*,

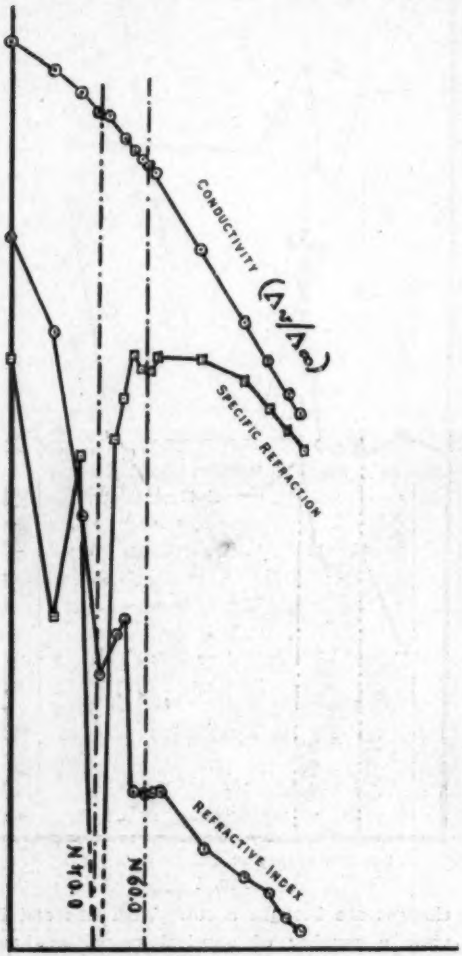


FIG. 2

0·1N. and 0·04N, indicating thereby that the phenomenon observed is a genuine one.

Evidences from Raman spectra[8] have also been obtained, which rule out the possible explanation of the formation of hydrates.

The following reactions are suggested to explain the various observations made:—

$$\underset{0\cdot10N}{\tfrac{1}{3}(HIO_3)_3} \rightleftharpoons \underset{0\cdot04N}{\tfrac{1}{2}(HIO_3)_2} \rightleftharpoons HIO_3 \underset{\downarrow\uparrow}{} H^+ + IO_3^-$$

The detailed paper will be published in *Zeitschrift fur anorganische und allgemeine Chemie*.

M. R. NAYAR.

Chemistry Department,
Lucknow University,
*February* 8, 1939.

[1] Thomson, J., *Ber.*, 1874, **7**, 112.

[2] Ostwald, W., *J. prakt. Chem.*, 1885, **32** (2), 310.

[3] Walden, P., *Z. phys. Chem.*, 1888, **2**, 64.

[4] Rosenheim and Liebknecht, *Lieb. Ann.*, 1899, **308**, 40.

[5] Groschuff, E., *Z. anorg. Chem.*, 1905, **47**, 331.

[6] Dhar and coworkers, *J. Ind. Chem. Soc.*, 1928, **5**, 585; 1929, **6**, 784; 1932, **9**, 322.

[7] Nayar, M. R., and Gairola, T. R., *Z. anorg. Chem.*, 1934, **220**, 163–68.

[8] Nayar, M. R., and Sharma, P. N., *ibid.*, pp. 169–72; Venkateswaran, C. S., *Proc. Ind. Acad. Sci.*, 1935, **2**, 119; Shen, Ya and Wu, *Phys. Rev.*, 1937, **51**, 235.

## Triplo-Polyploidy in *Saccharum spontaneum* L.

AN examination of a large number of clones of *Saccharum spontaneum* collected from various parts of India, Burma, and the East Indies have shown that this species includes a polyploid series with $2n = 48$, $2n = 56$, $2n = 64$, $2n = 72$, and $2n = 80$ in India and $2n = 80$, $2n = 96$, $2n = 112$ in further India and the East Indies. One would be led to conclude from these chromosome numbers that 8 is the basic number in this species and forms with $2n = 56$, $2n = 64$ and $2n = 72$ are $7x$, $8x$ and $9x$ forms respectively. The presence of an odd set of chromosomes in the $7x$ and $9x$ forms would naturally lead one to expect univalents or multivalents at meiosis in these types. A study of the chromosome behaviour of a number of clones collected in India have shown, however, that 28, 32 and 36 bivalents are formed regularly at meiosis in these types. Consideration of the above has led me to conclude

that these forms of the species are dibasic, having arisen by hybridization of a form with $(x = 10)$ and one with $(x = 6)$.

Of these two types $2n = 80$, $8(x = 10)$ which is a wide-leafed form (variety *ægyptiacum* of Heckel) is found distributed in the more tropical parts of South-Eastern Asia and East Indies, while the $2n = 48$, $8(x = 6)$ which is a thin-leafed form (variety *juncifolium* of Heckel, is confined to the subtropical region of North-Western Asia and Southern Russia. The form very widely distributed in Peninsular India is one with $2n = 64$, which I have considered as a natural hybrid between the $2n = 48$ and $2n = 80$ types (Janaki Ammal, 1936).[1] Its chromosome complement can be represented as $4(x = 6) + 4(x = 10)$.

Plants with 56 and 72 chromosomes have a more restricted distribution being found in mixed populations of the $2n = 64$ chromosome type and the two primary forms (varieties *juncifolium* and *ægyptiacum*) with 48 and 80 chromosomes respectively. I have also been

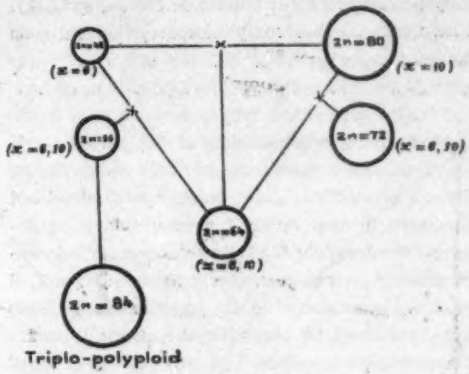


FIG. 1.
Diagrammatic representation of the types of *S. spontaneum* found in India and the relation of the "triplo-polyploid" to these forms

able to synthesize the $2n = 72$ type by crossing the wide-leafed Dacca *S. spontaneum* $(2n = 80)$

FIG. 2
A field of *S. spontaneum* showing the "triploid" giant amongst the diploids

with the local Coimbatore form ($2n = 64$) (Janaki Ammal, 1936 *b*).[2] On this basis they may be considered as true back crosses (Fig. 1). Their chromosome complexes are, therefore, as follows:

$$2n = 56 = 6(x = 6) + 2(x = 10)$$
$$2n = 72 = 2(x = 6) + 6(x = 10).$$

In studying a population of 100 selfed seedlings of a form with $2n = 56$ collected at Dehra Dun, I noticed two giant plants which stood out amongst the rest by their greater height, thickness of stem, width of leaves, size of inflorescence and increased sugar content (Figs. 2, 3 & 4). Chromosome counts in root tips of these plants showed 84 chromosomes which is thrice the haploid complement of the parent (Figs. 5 & 6). The plants are therefore "triploids", having arisen by the fertilization of an unreduced ($2n = 56$) gamete with a reduced one ($n = 28$). They are semi-sterile, but have yielded a number of seedlings on selfing. A study of meiosis in the "triploid" revealed the presence of univalents and multivalents besides a large number of bivalents. As the plant from which this "triploid" has arisen is already a complex polyploid, I have used the term "triplo-polyploid" to designate this type of derivation. In vegetative characters these "triplo-polyploid" plants stand intermediate between the *S. spontaneum* of India and the indigenous cultivated sugarcanes which they resemble. It is therefore not unlikely that


FIG. 4

Inflorescence of a "triploid" and two "diploid" *S. spontaneum* from the culture of selfed seedlings of the Dehra Dun form

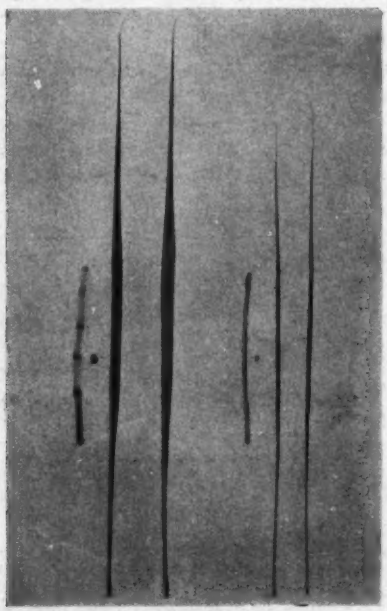

FIG. 3

Stem and leaves of "triploid" seedling of *S. spontaneum* (Dehra Dun) by the side of its "diploid" parent

FIG. 5

Somatic metaphase in *S. spontaneum*, Dehra Dun ($2n = 56$)

FIG. 6

Somatic metaphase in "triploid" seedling of the Dehra Dun *S. spontaneum* ($2n = 84$)

some of the sugarcanes of India have arisen from *S. spontaneum* as "triplo-polyploids". If it is so, there exists an interesting parallelism between the chromosome history of a cultivated plant like the sugarcane and the triploid mutants whose propagation as clones has likewise provided the best varieties of apples, pears, tulips and hyacinths.

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Imperial Sugarcane Station,
Lawley Road P.O.,
Coimbatore,
*January* 19, 1939.

[1] Janaki Ammal, E. K., *Ind. Jour. Agri. Sci.*, 1936, 5, 1.

[2] — *Report of the Sugarcane Geneticist*, from July 1935 to March 1936.

## Separation of Lac into Sclerolac and Soft Lac Resin

PREVIOUS work[1] has shown that lac could be separated into sclerolac, the hard lac resin, and the soft lac resin. The superiority of sclero- to ordinary lac[2] which consists in its higher melting point, low water absorption value, low acid value, better adhesive strength and its capacity for thermo-hardening, has not only extended the applications of lac but to a considerable extent stabilised its position in the varnish and electrical industries. Further, this has provided the necessary impetus for the manufacture of hard lac resin on a commercial scale.

There are three methods in vogue for the preparation of sclerolac from lac: (i) direct extraction with organic solvents which extract the soft lac resin,[3] (ii) 'cold polymerisation process'[4] involving the addition of urea to an acetone solution of lac whereby, the polymerised hard lac is precipitated, and (iii) extraction of lac with dilute alkali solutions or fractional precipitation from dilute alkali solutions.[2,5]

The first two methods entail the employment of rather expensive solvents and the extractions are accompanied by heat treatment which is not very desirable in the case of a thermo-hardening material like the hard lac resin. The third method, though it does not yield pure hard lac resin, is an economical process. The small amounts of buffer salts employed for the process, will have to be thoroughly removed and the product dried before use in varnish manufacture.

We carried out experiments to find out the nature of the products yielded on precipitating lac from an alcoholic solution with water. This is analogous to the precipitation of lac from an alcoholic solution with ether, although the separation is not quite so distinct and complete. By this method, the less acidic ingredients of lac separated out as a viscous mass from the solution, the more acidic ones remaining in the supernatant. A very important factor in favour of this method is that it does not involve much extra cost when adopted by manufacturers producing machine-made shellac. Moreover, there is no likelihood

TABLE I

| Treatment | Soluble fraction | | Insoluble fraction | |
|---|---|---|---|---|
| | Acid value | Wt. in gm. | Acid value | Wt. in gm. |
| *25 c.c. alcoholic solution of lac + 700 c.c. ethyl ether .. | 100·8 | 4·04 | 56·0 | 2·8 |
| * " " " + 8 c.c. distilled water .. | 88 | 3·34 | 71·8 | 3·68 |
| * " " " + 10 " " .. | 104·6 | 1·86 | 75·0 | 5·05 |
| * " " " + 12 " " .. | 125·7 | 1·09 | 75·8 | 5·68 |
| * " " " + 14 " " .. | 131·1 | 0·82 | 76·7 | 6·10 |
| 25 c.c. alcoholic solution of bleached lac *plus* 12 c.c. distilled water .. .. .. .. .. | 107·6 | 1·39 | 77·0 | 3·35 |

* The original alcoholic solution of lac had an acid value of 81·8 and a solid content of 27·65%.

of an alteration in the chemical nature of the products as no drastic chemicals are employed in the process. Almost the same result is achieved by extracting lac with aqueous alcohol of the proper strength.

Known volumes of distilled water were added drop by drop to a measured quantity of an alcoholic solution of lac with vigorous stirring, the resulting suspensions centrifuged in each case and the acid values of the residues and supernatant were determined along with the quantities of resin distributed in the two phases. For the determination of acid value of the hard lac resin, the solution was prepared with aqueous alcohol containing the same amount of water as was present in the soft lac resin solution. The results are shown in Table I.

The hard lac resin prepared by this method can be directly used with the requisite quantity of plasticiser for the manufacture of varnishes. There is no need to get rid of the little residual moisture present since it has a very high tolerance for water.[6]

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M. Sreenivasaya.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
*February* 7, 1939.

[1] Verman, L. C., and Bhattacharya, R., *Lond. Shellac Res. Bur. Tech. Paper* No. 1, 1934.

[2] Bhattacharya, R., and Gidvani, B. S., *ibid., Tech. Paper* No. 13, 1938.

[3] Verman, L. C., and Bhattacharya, R., *ibid., Tech. Paper* No. 5, 1938.

[4] Venugopalan, M., and Sen, H. K., *J.S.C.I.*, 1938, **57**, 371.

[5] Bhattacharya, R., and Heath, G. D., *Lond. Shellac Res. Bur. Tech. Paper* No. 16, 1938.

[6] *Oil Col. Tr. J.*, 1938, **94**, 1804.

## On Some Foraminifera from the Tertiary Beds near Surat and Broach (Western India) with Special Reference to the Occurrence of *Siderolites*

The Tertiary nummulitic limestones occurring between Surat and Broach have long been known to Indian geologists, and although the earlier workers like W. T. Blanford[1] thought that a part of these Tertiary rocks were Lower Eocene in age, subsequent studies mostly based on the nature of the molluscan fauna tended to obscure this view and led to the conclusion that the lowest Tertiary beds in this locality are much younger and are equivalent to the Kirthar series (Middle to Upper Eocene) of Sind,—a view which is the one now generally accepted.

I have recently had an opportunity of examining the tertiary rocks of this area with special reference to their foraminiferal contents, the value of which in the exact age determination of lower tertiary strata is coming to be increasingly realised—thanks to the recent work of Davies, Nuttall and others. In this note, I should particularly like to refer to the foraminiferal fauna which I have noticed in a thin band of limestone confined to the western fringe of the tertiaries, and very closely associated with the Deccan trap in this area. In this limestone, we see foraminifers like *Nummulites thalicus* Davies, *N. globulus* Leym., *Operculina* cf. *canalifera* d'Arch., and also a large variety of *Discocyclina*, closely similar to, if not identical with, *D. ranikotensis* Davies, an assemblage which is clearly indicative of a Ranikot age. In addition to these, we also notice in this limestone the important form *Siderolites* (Fig. 1), the occurrence of which is evidently of great interest and significance, seeing that elsewhere this form is considered as characteristic of the Upper Cretaceous, and forms apparently similar to this seen in Ranikot beds have now been shown to belong to another genus altogether—*Miscellanea*.[2,3] The form I have noticed in the Surat–Broach area is a true *Siderolites* and is here found in association with typical Ranikot species of *Discocyclina* and *Nummulites*. Thus it would appear that the limestone containing this foraminiferal assemblage is of Ranikot age, and represents its lowermost horizon, probably equivalent to the Hangu shales.[4]

The occurrence of a Ranikot bed as part of the Tertiary sequence in this area has evidently an important bearing on the problem of the extent of the Ranikot sea in India, and shows

that this sea must have extended as far south as Surat and Broach. A detailed study of the relationship between this Ranikot bed and the

FIG. 1
Section of *Siderolites*-bearing limestone from Tarkeshwar, near Surat. × 20.

Deccan trap of the area with which it is closely associated, will also be of great value in discussing the age of these traps.

My grateful thanks are due to Lt.-Col. L. M. Davies (Edinburgh) and Prof. L. Rama Rao (Head of the Department of Geology, Mysore University) for the valuable help I am receiving in this work, and to the Director, Geological Survey of India, for loan of literature.

S. R. NARAYANA RAO.

Department of Geology,
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*January* 30, 1939.

1 Blanford, W. T., *Mem. Geo. Sur. Ind.*, 1869, **6**, 225.
2 Pfender, J., *Bull. Soc. Geo. Fr.*, 1934, **4**, 225–36.
3 Davies, L. M., and Pinfold, F. S., *Pal. Ind.*, N.S., 1937, **24**, Mem. 1, 40.
4 Davies, L. M., *Pal. Ind.*, N.S., 1930, **15**, Pt. 1, 10

## The Ovule and Embryo-sac Development of Some Malpighiaceæ

SCHÜRHOFF[2] (1924) who investigated the development of the embryo-sac in some Malpighiaceæ, *Malpighia coccifera*, Linn., *M. urens*, Linn., and *Bunchosia nitida*, Jacq., has recorded sixteen-nucleate embryo-sacs developing after "Peperomia-type". A similar type of development has been recorded in *Hiptage madablota*, Gaertn., *Banisteria laurifolia*, Linn., and *Stigmatophyllum aristatum*, Linn. (Subba Rao,[4] 1937) and *Malpighia punicifolia*, Linn. (Narasimhachar,[1] 1938). Stenar[3] investigated the development of the female gametophytes in *Malpighia urens*, Linn. and *Galphimia gracilis*, Bartl., and confirmed the observations of Schürhoff on *Malpighia urens*. But he records an "Allium-type" (Scilla-type) of embryo-sac development in *Galphimia gracilis*.

The characteristic orientation and development of the ovule in *Malpighia urens* are described by Stenar as follows:—When the ovule contains a magaspore-mother cell the inner integument is very small and the outer passes on the ventral side of it up to the very top of the nucellus. Later the outer integument grows fast and forms an arch over the nucellus by the time the embryo-sac is four nucleate. The inner integument forms a ring round the nucellus which passes out of the big aperture and enlarges. A longitudinal section of the apical part of the nucellus gives the appearance of a soleshaped structure.

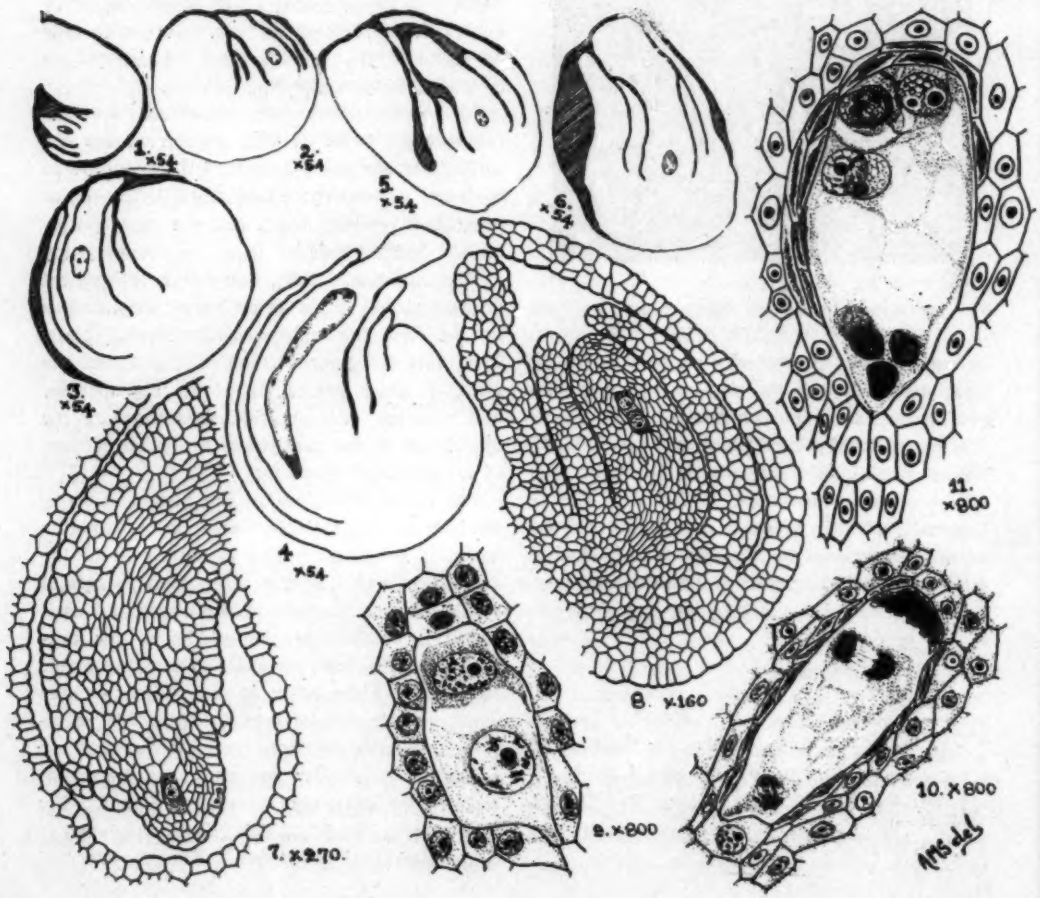
The megasporangium in the genera Hiptage, Banisteria, Stigmatophyllum and Malpighia takes its origin on a lateral outgrowth of the carpellary wall. In the very young stages it points towards the base of the ovary, but as it grows it bends near the middle of the outgrowth and points upwards. The integuments take their origin early in the history of the ovule. Their development in *Malpighia coccifera*, *Banisteria laurifolia* and *Stigmatophyllum aristatum* is similar to what has been described for *Malpighia urens* by Stenar. The big "Nucellar-beak", which is best developed in *Stigmatophyllum aristatum* (Fig. 6),—formed

by the rapid multiplication of the parietal and epidermal cells,—projects beyond the outer integument, just when the embryo-sac is four nucleate (Figs. 5 & 6), and gives a characteristic appearance. It is difficult to identify the integuments when the ovule contains a mature embryo-sac.

In *Hiptage madablota* the outer integument remains short and the inner alone grows further (Figs. 1–4). The nucellus projects beyond the inner integument and swells up. The integuments remain distinct even when the embryo-sac has a few-celled embryo (Fig. 4).

In *Malpighia glauca* Poir., the development of the integuments is more normal (Figs. 7 & 8). Even here the identity of the parietal cells is lost in older stages. As in *Galphimia gracilis* the nucellus is normal in size and it completely remains within the integuments without enlarging.

The ovules in *Malpighia coccifera* Linn. and *Tristelletia Australis*, Linn. develop as in *Malpighia urens*. The primary archesporial cell, in both, cuts off parietal cells and becomes deeply situated in the nucellus. Of the many archesporial cells only one functions as the magaspore-mother cell. The development of the embryo-sac proceeds after the "Peperomia-



type" as described for the genera Hiptage, Banisteria, Stigmatophyllum, Malpighia and Bunchosia. The mature embryo-sacs are sixteen nucleate with four groups of three nuclei with no definite organisation into the egg and synergids; and four nuclei fuse in the centre to form the secondary nucleus. The plants do not set seeds here.

The embryo-sac of *Malpighia glauca* develops after the "Allium-type" (Scilla-type) as described by Stenar for *Galphimia gracilis*. The primary archesporial cell after cutting off parietal cells functions at the megaspore-mother cell. Multiple archesporium has not been observed. The mother cell by the heterotypic division gives rise to two approximately equal cells (Fig. 8). The chalazal enlarges and the micropylar degenerates. The nucleus of the chalazal cell divides to give rise to a two-nucleate embryo-sac which ultimately develops into an eight-nucleate one (Figs. 10 & 11). Of the four nuclei in the micropylar end, three organise themselves into the egg-apparatus and the fourth fuses with a nucleus of the chalazal end and forms the secondary nucleus. The antipodals are fairly large and degenerate by the time the fusion of the polars is complete.

Further work on the development of the embryos is in progress and the details will appear elsewhere as a separate paper.

Acknowledgments are made to Dr. M. A. Sampathkumaran and Professor L. Narayana Rao for encouragement and kind guidance.

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*January* 24, 1939.

[1] Narasimhachar, S. G., *Curr. Sci.*, 1938, **6**, 507.

[2] Schürhoff, P. N., Extract from *Die Zytologie der Blütenpflanzen*, Stuttgart, 1926.

[3] Stenar, Helge, *Bot. Notiser*, 1937, 110–18. (Reprint received for reference by the kind courtesy of Dr. P. Maheshwari, University of Allahabad.)

[4] Subba Rao, A. M., *Curr. Sci.*, 1937, **6**, 280.

[5] — *Studies in the Malpighiaceæ*, 1939 (in course of publication).

[6] Maheshwari, P., *New Phyt.*, 1937, **36**, 359.

## Growth of *Pythium hyphalosticton* Sideris in Synthetic Nutrient Liquid Media

ROBBINS AND KAVANAGH[1] reported that *Pythium hyphalosticton* and *Pythium aphanidermatum* (Eds.) Fitz., (*P. Butleri*) failed to grow uniformly in their medium C consisting of 5·0 gm. of $MgSo_4 \cdot 7H_2O$, 15·0 gm. of $KH_2PO_4$, 5·0 gm. of asparagine, 0·5 gm. of $NH_4NO_3$, 50·0 gm. of dextrose and 1 c.c. of mineral supplements per litre of redistilled water, either with or without the addition of vitamin $B_1$. This medium had a pH of 4·3. They write (p. 231), "We are uncertain whether the failure of these organisms to develop was due to unsatisfactory material used in the inoculation, to the unfavourable character of the basic medium (hydrion concentration, solute concentration), or to lack of growth substances other than vitamin $B_1$".

The culture of *Pythium hyphalosticton* Sideris, which is with the author, was obtained from Centraalbureau voor Schimmelcultures, Baarn (Holland). Several nutrient liquid media (10 c.c. in pyrex tubes) were tried. The asparagine was taken up in redistilled water and precipitated with alcohol. This process was repeated thrice. Stock cultures were maintained on oatmeal agar and potato dextrose agar. A bit of mycelium was used as inoculum, care being taken to avoid including any of the agar of the stock cultures with the inoculum, and each tube, after inoculation, was gently shaken the next day to allow the inoculum to sink down in the nutrient solution. The standard incubation was at 25° C. for seven days. At the end of this period cultures were examined microscopically. All experiments were performed in triplicate and all experiments were repeated. Guaranteed reagents of Merck & Co., were used. The hydrion concentrations were determined after autoclaving.

*I Series:*

Solution A: It contained 0.5 gm. each of $K_2HPO_4$, $MgCl_2 \cdot 6H_2O$, $K_2SO_4$, 2·0 mg. of $NH_4NO_3$ and 5·0 gm. of dextrose per litre of distilled water.

This solution was inoculated with *Phytophthora erythroseptica* Pethybridge,[2] *Phycomyces Blackesleeanus* Burgeff (+ strain), *Phytophthora fagopyri* Takimoto and *Mucor Ramannianus* Möller,[3] but there was no growth of these in any case, indicating that the medium was free from thiamin, pyrimidine and thiazole.

Solution B: It contained 0·1 gm. each of $K_2HPO_4$, $MgCl_2 \cdot 6H_2O$, $K_2SO_4$, 0·8 gm. of $NH_4NO_3$ and 1·0 gm. of dextrose per litre of distilled water.

The pH of solutions A and B was 6·8.

The author finds that *Pythium hyphalosticton* grows well in solution A and also in a dilute solution, *i.e.*, B and is transferable in them.

In view of the fact that the fungus grows in the nutrient solution free from vitamin $B_1$ the author thinks that it is one of those fungi, which do not require any organic growth supplement from extraneous sources but manufacture their own growth-promoting substance or substances from the elementary materials of the nutrient medium. There are indications that thiamin or its intermediates synthesized by the fungus are given off by the mycelium into the medium. These results, which require further verifications, will be published in a subsequent note.

*Pythium hyphalosticton* resembles *Pythium aphanidermatum*[4,5] and many other fungi in its ability to grow in a suitable synthetic liquid solution, which lacks any organic growth supplement.

*II Series*:

Solution C: This was medium C used by Robbins and Kavanagh. Its composition is given in the beginning of this note. Its pH was 4·3.

Solution D: This was made by diluting solution C five times (*i.e.*, 100 c.c. of solution C + 400 c.c. of redistilled water). Its pH was 4·5.

Solution E: This was prepared by diluting solution C ten times. Its pH was 4·75.

Solution F: This was prepared by adding sufficient quantity of $K_2HPO_4$ to solution C to make its reaction pH 5·3.

Solution G: This was prepared by diluting solution F five times. Its pH was 5·5.

Solution H: This was prepared by diluting solution F ten times. Its pH was about 5·6.

In solution C the organism did not grow at all, while in solution F it made no appreciable growth. In solutions D, E, G and H there was very good growth of the fungus, the colonies of which rose up to about 5 cm. in height in tubes and formed thick mycelial felts on the surface of the nutrient liquids, and in these it was transferable.

It has already been demonstrated that the fungus can grow in suitable synthetic solution without any organic growth supplement from an extraneous source. Therefore, its inability to grow in solutions C and F cannot be due to lack of some growth supplement, or to lack of some nutrient ingredients since it grows in them when they are diluted five or ten times. The experiments demonstrate that the concentration of solutions C and F interferes with the growth.

Robbins and Kavanagh have obtained similar results with *Pythium aphanidermatum*, which is also capable of unlimited growth when the solutions, used by them, are diluted.

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*January* 26, 1939.

[1] Robbins, W. J., and Kavanagh, F., *Am. Jour. Bot.*, 1938, **25**, 231.

[2] Leonaian, L. H., and Lilly, V. G., *Phytopath.*, 1938, **28**, 533 and 540.

[3] Robbins, W. J., *Bull. Torrey. Bot. Club*, 1938, **65**, 274.

[4] — and Kavanagh, F., *Proc. Nat. Acad. Sci.*, 1938, **87**, 429.

[5] — — *Bull. Torrey. Bot. Club*, 1938, **65**, 453–61.

## Insecticidal Plants

With reference to the note on "Insecticidal Plants" appearing in *Current Science*,[1] we write to say that work in this direction and more especially with Derris, *Derris ferruginea*, Pyrethrum, *Chrysanthemum Cinærariefolium* and *Tephrosia* spp., is in progress at our Institute

since the last 18 months. The stock raised from our experimental nursery under control conditions has been distributed to different parts in the State to study the effects of varying soil and climatic factors. Details regarding their sylviculture, active principle content, etc., will be published elsewhere. We should like to record here that, contrary to the widespread impression that Pyrethrum does not flower below an altitude of 6,000 feet, the species has flowered both at Bangalore (ca. 3,100 ft.) and at Kemmangundi (ca. 5,000 ft.).

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*January* 3, 1939.

[1] *Curr. Sci.*, 1938, **7**, 258.

## A Type of Boomerang from Palanpur

Of the two types of boomerangs used in India the so-called returning type is figured both in Egerton's[1] book and in Thurston's.[2] The other type is, as far as I can know, figured only once in Egerton's[3] book. The two specimens of the first type figured by Thurston differ among themselves as well as from the specimens figured by Egerton as regards their curvature. The type occurs both in Gujarat as well as in South India as seen from the description of the specimens by Egerton[4] and Thurston.[5] Gujarat specimens are made of wood while South Indian ones are either of wood or of ivory. The other type called 'Katar' or 'Katariya' and described by Egerton as used by 'Koles' (Kolis) of Gujarat is made of wood. The one specimen of this type figured by him shows rather a sharp angle at the centre. Three such specimens are recorded by him and their length on the outer curve is given to be 2' 6" to 3'. He has not given measurements of width.[6] Egerton lists[7] and describes a boomerang 'Singa' from Southern India as made of steel with a length of 18" to 21" and a width of 2½" to 3". From the description, with width specified, it appears that this boomerang of steel from Southern India may be of the type of the simple boomerang of the second type and described by Egerton as being used by the 'Koles' of Gujarat. If it is so, and here I should mention that the specimen is not figured anywhere, this ordinary boomerang, like the other one, is in use both in the North as well as in the South. What the shape of the Southern type may be it is not possible to judge, for lack of illustration.

While on tour in the State of Palanpur in February 1938, I procured a specimen of the ordinary type of boomerang used by lower classes for hunting small game. The length of the curve on the outer side is 29·5" and the width of the two ends is 1·5" and 1·3" respectively. As the illustration makes it clear,

the specimen has a more flowing curve than the specimen illustrated by Egerton. Perhaps the nature of the curve of this implement depended more on the natural curve of the wood used than on conscious selection.*

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*February* 14, 1939.

[1] *An Illustrated Handbook of Indian Art*, 1880, Fig. 15, 4, p. 73.

[2] *Ethnographic Notes in Southern India*, 1907, Pl. XXXVII.

[3] *Loc. cit.*, Fig. 15, 1.

[4] *Loc cit.*, pp. 78–81.

[5] *Loc. cit*, p. 56.

[6] *Loc. cit.*, p. 78.

[7] *Loc. cit.*, p. 81, No. 70.

* The specimen is deposited in the Government Museum, Madras.

## INDUSTRIAL SECTION

# Modern Distillery Practice as an Adjunct to the Cane Sugar Factory

By G. Narasimha Iyengar

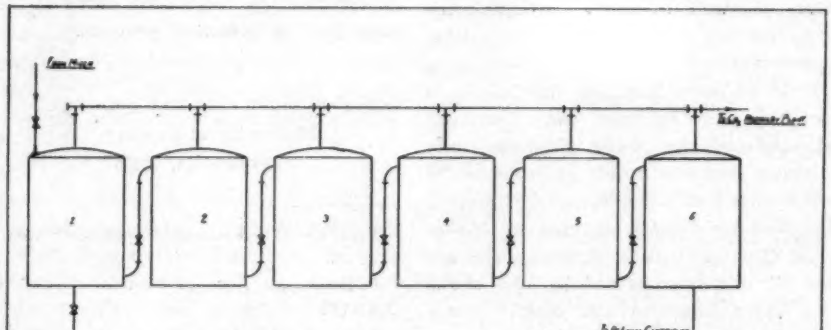
*(Distillery, The Mysore Sugar Co., Ltd., Mandya)*

WITH the development of the Indian Sugar Industry the problem of the economic disposal of molasses has ushered to the forefront the Fermentation Industry. The economic advantages accruing from the running of the distillery as an adjunct to the sugar factory may be considered. The sugar factory being a seasonal one, it is of advantage to run the distillery, the working of which is synchronous with the running of the sugar factory. Steam for distillation is taken from the sugar factory where steam is raised by the burning of bagasse and thus the steam which is one of the important items of cost in the distillery is obtained cheaply.

Louis Pasteur found that 51·110 kg. of alcohol, i.e., 64·34 litres of 100° G.L. alcohol could be obtained from 100 kg. of sugar (dextrose). But practically 61·11 litres of alcohol has been the maximum yield. The difference of 3·2 litres per 100 kg. of glucose or 5·2% less than the theoretical possibility has been shown as being due to the utilisation of the sugar for the building up of the cell.

The old method consists in producing yeast—*Saccharomyces cerevisiæ*—during the fermentation of the Wort, while the multiplication of the cells goes on, and a large quantity of sugar being used for production and building up of the cells. In this new method the aim has been to minimise the losses of sugar utilised in the building up of the cells and the utilisation of this sugar in the production of alcohol.

This is realised in practice by separating from the fermented wash the adult cells (before they have lost their fermentative capacity) and "pitching" the yeast so recovered into the same volume of sugar solution so that the same concentration of cells is maintained and these adult cells convert the sugar into alcohol and carbon dioxide. It is said that the same batch of yeast could be kept for a length of 3 to 4 months and by this method from time to time a very small number of cells would die out and these are replaced by the very small number of cells reproduced during fermentation.



The apparatus consists of a number of Fermenters of equal capacity interconnected by means of pipes as shown in the figure. Initially the pure yeast culture which is acclimatised to the conditions obtaining

in large-scale fermentation is grown to about 5% of the volume of the first fermenter and then this is "pitched" into the diluted molasses solution from the dilution tanks and when this is full the cock communicating I and II is opened and the diluted molasses solution is fed into the second fermenter; when this gets filled, the cock communicating the II and III is opened and so on till the last is reached, the rate of filling being so adjusted that by the time the last fermenter is reached the fermentation is more or less complete. From this last fermenter the fermented wash before being sent for distillation is sent to a De Laval Centrifuge which is a modification of the milk centrifuge. Here the yeast is separated from the wash, the other deleterious bacteria being also carried with the latter. The amount of yeast recovered is about 10% of the volume of the wash centrifuged and this yeast is sent to a mixer where the original proportion is maintained and from this the mixture of yeast and sugar solution is run into the first fermenter. The cycle goes on continuously. The Vats are covered and the fermentation is carried on out of contact with oxygen when the multiplication of cells and the utilisation of sugar for the building up of the cells is arrested. According to Slator,[1] the rate of fermentation of dextrose by yeast is proportional to the concentration of the yeast and is independent of the concentration of sugar except in very dilute solutions. Since adult cells are used the period of incubation necessary is saved and the concentration of the cells being constant the period of primary fermentation is carried on more expeditiously. The advantages of this method over the old one may be considered:

1. The speed of fermentation is increased and time of fermentation is about half to two-thirds, the time taken by the old process, thus facilitating the use of more concentrated worts resulting in "richer" wash and consequential steam economy. Thus the capacity of the fermentation room is increased to 30 to 50% of the original thus increasing the output. Since the volume of wash handled is diminished the capital investment on a larger number of fermenters is saved.
2. Since the bacteria are separated, purity of fermentation is maintained resulting in a purer alcohol.
3. The yield of alcohol is increased from 2 to 4% as the sugar, which would otherwise have been used for the building of cells, has been reduced to a minimum.
4. Encrustation of the wash column is prevented as the yeast is separated from the wash before distillation. In the ordinary process the wash column is encrusted for a normal working of 150 days necessitating the cleaning of the column before distillation.
5. Longer life of the fermenters as the amount of acid to be used is considerably less.

The patent rights for this process has been with Usines de Mille and the cost of the equipment including royalty is more than met with by the above advantages. The centrifuge is obtainable in two sizes, (1) which permits the separation of all the yeast at 100–200 H.L. per hour and is recommended for distilleries of 150–300 H.L. capacity per day, and (2) which separates between 50–100 H.L. per hour and is recommended for distilleries of 50–100 H.L. per day. The power required for this is between 1·5–2 H.P. Now many of the distilleries on the Continent are using this process. It is of advantage as aforesaid to run the distillery side by side with the factory and increase the output per day thus reducing the cost of production. This is a very important factor especially when the alcohol is to be used for power-raising purposes in preference to other fuels, since one of the objections raised has been the "high" cost of alcohol which would enhance the price of the alcoholised motor fuel.

The working of one of the important distilleries may be cited.

Original capacity (by the old method) 500 H.L. per day.
Number of working days—100.
Increased production by the new process 1250 H.L. per 100 days.
Thus, increase in production—2.5%.
Speed of fermentation increased between 30–50%.
Encrustation of the wash column diminished.

With the Power Alcohol Scheme on the anvil of the National Planning Commission one can visualise a greater advantage of the employment of this process in distilleries working as an adjunct to the Sugar Factory in the near future, in India.

[1] Slator and Sand, *J.C.S.*, 1910, **97**, 922.

# Fuel Research in the United Kingdom*

THE latest annual report of the Department of Scientific and Industrial Research, recording the progress of a number of activities of the Fuel Research Board, like the previous numbers, is divided into many sections; and experimental data are included wherever necessary in the form of tables and graphs with a view to throw sufficient light on the work under review. A few photographs and diagrams of special semi-industrial plants are also included.

At the outset, satisfaction is expressed in respect of the voluminous and extremely valuable work carried out by the field laboratories established in the major mining areas by way of undertaking "a survey and classification of the coal seams in the various mining districts by means of chemical and physical tests in the laboratory", which was one of the main lines of research of the Board. This has been achieved with the closest co-operation of the colliery owners, the users of graded fuel and other organisations. The information has been of great value not only for the marketing purposes of the coals, but also to gain an idea of the Nation's potentialities. Several difficulties in conducting the work at a central place—in the nature of proper sampling, transportation of tons of samples, etc.—have been overcome by the establishment of laboratories in the coal-fields, only the correlation and special work being carried out at the central research station.

In view of the experience gained, the previously standardised methods of analysis of coal and ash have been modified. The presence of certain elements—Barium, Titanium, Nickel, Zinc, etc.—have been detected in certain coal samples, and by submitting certain coal ashes to spectroscopic examination the presence of those elements not normally associated with coal ashes, *e.g.*, Vanadium, Chromium, Lead, Germanium, Gallium, Silver and Copper has been revealed.

Some of the University Laboratories have been engaged in special investigations on the oxidation of carbon and the constitution of coal, subjects of considerable technical importance and also of intrinsic scientific interest, and views on the results achieved so far have been recorded.

Owing to the considerable attention paid to the sized grades of coal put on the market, work carried out by the Board has included investigations on the types of 'picks' used in breaking, the avoidance of unwanted breakage and the undue formation of fines, and the wet and dry methods of cleaning coal. They have been able to overcome the dust nuisance commonly attached to the coal conveyers, screening plants, etc., by sprinkling certain fluids in very small proportions on the broken coal. This method of dust-proofing coal has the additional advantage of protecting coal from weathering. A study of the physical structure of coal, employing *inter alia* the X-ray methods, has been of considerable interest in the determination of the absorption properties of certain fluids by different types of coals.

In regard to the work on carbonisation and gasification of coals, attention has been specially directed to the utilisation of low grade coals for metallurgical purposes by studying the characteristics of special blends, and the production of gases of special composition required for the development of synthetic processes for the production of oils and fatty acids. The investigations were carried out on the different types of large-scale retorts and the necessary working conditions have been ascertained for the success of the processes. Interesting results have been recorded with the modified operation of water gas plants fitted with a chamber for the catalytic reduction of carbon monoxide to methane, on the lines suggested by Sebastian. The results have been encouraging and water gas of high calorific value may some day be expected to be supplied to consumers instead of the more expensive coal gas.

Coal tars and oils have been subjected to hydrogenation in order to obtain motor spirit. In this connection, observations on the treatment of low temperature and high temperature tars have been recorded and it is suggested that the latter are not amenable to the treatment to the same extent as the former. Results of a mild hydrogenation treatment of crude benzole have been recorded to show how the process can be successfully worked for desulphurization of the hydrocarbon.

As a result of the cracking of higher boiling 'hydrogenated oils' unsaturated hydrocarbons are obtained which, when polymerised, give oils with lubricating properties. The results of this investigation have been encouraging to such an extent that a semi-technical scale plant has been designed and operated to synthesise olefines from mixtures of carbon monoxide and hydrogen, after the Fischer-Tropsch reaction. The large quantities of synthesised olefines—particularly ethylene—are next subjected to polymerisation in the presence of catalysts. This work has yielded a variety of products, such as lubricating oils, waxes for soaps, and acids for the production of esters.

Besides the continued progress of the process of hydrogenation of coal, steps have been taken to use pulverized coal in internal combustion engines where partial success has already been attained. Designing of long-wearing engine cylinder parts is one of the important items in this investigation.

The Board has been taking keen interest in the design of open fire grates for burning blended cokes, a problem of wide interest.

The report is a record of the multifarious activities in which the Board is engaged. The necessity for establishing such an institution in India has been stressed from time to time by all those having some kind of interest in the country's fuel problems. At present, investigations even of a preliminary nature are in progress in a few laboratories only, and there are evidently numerous difficulties in undertaking extensive research schemes whereby the coal

* *Report of the Fuel Research Board* (His Majesty's Stationery Office, London), 1938. Pp. x + 255. Price 4*s.* nett.

resources could be properly surveyed and classified; but then alone can a proper control be obtained on the economic utilisation of fuels in general. The Geological Survey of India have issued a number of bulletins from time to time embodying the preliminary work of an analytical character regarding some coalfields. The fuel laboratories of the Universities of Bombay and Calcutta and the Indian School of Mines have been adding to the meagre information on most of the coal deposits from time to time; but the work will have to be much wider in scope to enable the mining proprietors and coal users to profit by it. The outstanding results achieved by the Fuel Research Board in England, which have been partly recorded in the report, should be enough to stress the importance of an organisation of that kind to this country.

M. R. MANDLEKAR.

## Modern Tendencies in Mathematics*

DURING the last hundred and fifty years, not only an immense advance has been made in the direction already indicated by the old masters like Descartes, Newton, Leibnitz, Euler and Lagrange but entirely new branches of mathematics were created such as Projective Geometry, Functions of Complex Variables and the whole vast subject of mathematical physics. Sometimes, the development in mathematics went hand in hand with the progress of the natural sciences, and new methods of attack were developed in order to solve the problems set by these sciences. At other times the trend of events has been in the opposite direction. Many subjects in mathematics were developed purely for their own sake, and it was only at a later date that most of these abstruse ideas found applications in practical problems. Complex Variables, Differential and Integral Equations, Tensors, Quaternions, Matrices and Groups have become powerful tools in the hands of the physicist. Having conquered the domain of the natural sciences, mathematics continues in its triumphal march into the realm of the biological and sociological sciences as well. It is thus becoming more and more indispensable for all knowledge and the conviction is gaining ground that the formulation of all the fundamental laws of nature requires its use.

Another characteristic development of modern times is the rise of the deductive method. In mechanics, for example, it has become customary to start with Hamilton's variational principle and deduce Newton's Laws. This tendency has resulted in the unification of various theories and various branches of knowledge.

Dr. Siddiqi pointed out that the progress of mathematical sciences up to the nineteenth century was mainly in the constructive direction, that is, in the direction in which we start from familiar conceptions and then advance in a synthetic way towards gradually increasing complexity. But with Gauss, the critical discipline was also introduced. Gauss and Cauchy were the first mathematicians to realise the insecure foundations on which mathematics was built, and they turned their attention to a critical examination and rigorous formulation of the whole subject. This work was carried on by Abel, Riemann, Weirstrass, Dedikind and Cantor. This process led to the great and important movement called "the Arithmetisation of Mathematics", started by Kronecker and Weirstrass. The greatest achievement of the late nineteenth century was Cantor's theory of sets, and his first mastery over the world of infinity. It has had a far-reaching influence both on pure mathematics and its applications. The theory of sets contributed a great deal towards clearing the foundations of mathematics, but the theory itself was not founded on a secure basis, as it led to many paradoxes. Investigations connected with these difficulties have thrown much light on many of the most fundamental problems of human knowledge. The solution has been attempted in three different ways by different schools. The difference is not only methodical; it consists mainly in the whole mathematical outlook.

The Intuitionistic School, led by Bronwer and Weyl, considers pure existence theorems as illegitimate. For this school existence in mathematics means constructability. It also rejects the age-old "Principle of Excluded Middle", i.e., the principle that out of two opposites one must hold. It applies this to the Decision-problem, and says that contrary to the general belief, every mathematical problem is not necessarily soluble.

The Logistic School of Bertrand Russell forbids the use of non-predicative definitions. It has revived the old idea that mathematics is a part of logic. This conception of logicism has had a sequel in the modern tendency to do away with the ordinary language, with its uncertainties and confusion, and to use a purely symbolical language.

The Axiomatic or Formalistic School has been founded and developed by David Hilbert. The axiomatic method, as distinguished from the genetic method, tries to build up a subject on a system of suitably chosen axioms. The fundamental problems then are those of proving the independence, completeness and self-consistency of the axioms.

The controversy between these different schools of thought is still raging, and it is not yet possible to forecast the direction to which mathematics of the future will tend.

* From an Extension Lecture delivered by Prof. R. Siddiqi on 10th January 1939, under the auspices of the Aligarh Muslim University.

## Vitamin A Deficiency and Night Blindness

THE relationship between night blindness, or dark adaptation, and vitamin A deficiency remains inconclusive despite tests with various optical instruments to determine the status of vitamin A nutrition from the values of threshold measurements, according to a note recently issued by Messrs. Bausch & Lomb, Rochester, New York.

The phenomenon known as dark adaptation, the ability to see in relative darkness after exposure to light, has been studied extensively. Fundamentally the process is a photochemical reaction in which visual purple, the light-sensitive pigment in the rods of the retina, is desensitized to dim light by exposure to bright light and resensitized to dim light through regeneration in darkness.

Photometric tests conducted by Palmer and Blumberg in a routine survey of 585 school children showed a great variation in successive tests of the same individuals. These findings were interpreted as indicating that very little dependence could be placed on results based on single tests of children and that methods for classifying photometric measurements to represent different degrees of vitamin A deficiency were inadequate.

This opinion has been confirmed by the recent study of Dr. Carroll E. Palmer, in a paper presented before the Child Hygiene Section of the American Public Health Association.

Selecting a group of school children whose dark adaptation tests indicated vitamin A deficiency, borderline subnormal, and a few normal, Dr. Palmer separated them into two groups, one for a series of feedings and the other as a control. Preliminary to the feeding study, each child received three light threshold tests to obtain data on the reliability of the readings. Following this each child was given a test every week for five weeks, during which each child in the feeding group received an average of 18,000 International Units of vitamin A daily, or a total of 630,000 I.U. in five weeks, in the form of halibut liver oil capsules. The control group received daily supplements of 0·05 International Units of the vitamin in similar capsules.

A series of visual threshold readings were made following a standardized exposure of the subject's eyes to bright light. Readings were made at 25 seconds and at 10 minutes, following exposure to bright light. Adaptation occurs in two parts, the first begins at once; it is rapid and attributed to cone function. The second part occurs later and is due to rod function. The intensity range covered by the rods and cones during dark adaptation depends upon the colour of the light, its area and retinal location, and the intensity of the preceding light adaptation.

Palmer's analysis showed marked improvement in the averages of the threshold measurements in successive tests on both groups of children. In the first preliminary test both the feeding and the control group indicated vitamin A deficiency. The average for the group that was subsequently given large doses of vitamin A was a little lower than that for the control group.

On the fourth preliminary test, however, the averages for the two groups were identical. During the five weeks of supplementary feeding, the averages for both groups continued to increase. At the end of the experiment approximately 45 per cent. of both groups gave readings below what is considered normal. The two groups were essentially alike at the end of the feeding period.

"As a result of these findings, particularly in view of the enormous variability of the measurements," reports Dr. Palmer, "it is not possible to attribute the improvement in the measurements conclusively to the supplementary vitamin feeding."

The shortcomings of the photometric technic, with any instrument at present available, indicate that no interpretation of vitamin A deficiency by this means is dependable.

Dr. Palmer reports that "The possibility exists that few or no children with vitamin A deficiency were actually included in his study". "These latter impressions," says he, "are further supported by the findings of the present investigation that a large proportion (45%) of the children who originally had subnormal or borderline readings failed to give normal adaptation measurements at 25 seconds even after receiving vitamin A concentrates.

"If such a large proportion of apparently healthy children fail to give normal measurements after supplementary feeding, it seems indicated that the proposed photometric standards for dark adaptation measurements may be incorrect or too rigorous."

Dr. Palmer concludes that the photometric technic in its present form cannot be considered a reliable or satisfactory method for detecting mild forms of vitamin A deficiency in children. "Careful evaluation of all the evidence now available reveals that conclusive results, either favourable or unfavourable, have not yet been obtained".

In addition to the inadequacy of present instruments and methods, night blindness, or slow adaptation, may be a corollary to various pathologic conditions which create variations in the readings.

# CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
*(University Librarian, Madras)*

## Bartram, William (1739–1823)

WILLIAM BARTRAM, an American naturalist, was born February 9, 1739 in the house of stone erected by his father John with his own hands in his Botanic Garden (the first in the new world) in Philadelphia. William early displayed great talent for drawing natural objects. Various trades were attempted; for example, Benjamin Franklin offered to teach him printing. In 1765–66, he accompanied his father in exploring all the 400 miles of St. John's River. In 1773–77, William explored the south-eastern part of the U.S.A. In 1782 he was elected Professor of Botany in the University of Pennsylvania but declined the position for reasons of health.

### His Fame

The chief cause of Bartram's fame is his fascinating *Travels through North and South Carolina, East and West Florida, the Charokee Country, the Extensive Territories of the Muscgulges or Creek Confederacy and the County of the Chactaus.* It was republished and translated in England, Ireland, Germany, Holland and France. The literary influence of the *Travels* was immense. "It is a work of high merit every way" wrote Coleridge, whose *Kubla Khan* is as much based on it as Wordsworth's *Ruth.* The *Travels* reveal a man with a deep reverence for the Creative Spirit he felt in all about him. For him the solitary "Woodpelican", alone on the topmost limb of a dead cypress, "looks extremely grave, sorrowful and melancholy, as if in deepest thought" and we find Wordsworth echoing the same in the *Prelude*

....and the pelican
Upon the Cypress spire in lonely thought
Might sit and sun himself—Alas! Alas!
In vain for such solemnity I looked.

### His Honours

Bartram's varied knowledge was at the service of all who applied to him; he corresponded with naturalists abroad and was a member of many foreign societies. In his own country he became (1786) a member of the American Philosophical Society, which was founded by his father and Benjamin Franklin. His thought, his findings and his drawings were freely incorporated in the contemporary books. Alexander Wilson's *American ornithology* (1808–14) owed its inspiration to Bartram.

### His End

Bartram lived as a bachelor in his father's Botanic Garden all through his later life. He had just finished writing the description of a plant and was stepping out for a stroll in his beloved Garden, when a blood vessel in the lungs ruptured and he died suddenly, July 22, 1823.

## Gibbs, Josiah Willard (1839–1903)

JOSIAH WILLARD GIBBS, an American mathematician, was born in New Haven, February 11, 1839. Both his parents were graduates. He took prize in Mathematics and Latin in Yale College and graduated in 1858. He took a doctorate in 1863 and after teaching Latin and Natural Philosophy for some time he spent three years in Europe and came under the influence of several of the most distinguished mathematicians and physicists of the world. In 1869, he returned to New Haven and in 1871 he was appointed Professor of Mathematical Physics in his own college and he continued as such for thirty-two years until his death.

### His Influence

As the classics were the fashion in those days, he attracted few advanced students. He is said to have remarked a year before his death that during thirty years of his professorship he had had only about half a dozen students really equipped to profit by his lectures. Gibbs' influence came chiefly from his writings.

### His Contributions

Multiple algebra, vector analysis, thermodynamics, theory of light and theory of electricity were the fields of knowledge enriched by the twenty-one papers and the two books of Gibbs. Most of the papers were published in the *American journal of science.* Of the books, *Vector analysis* was first privately printed (1881–84) for the use of his class and published in 1901 in a greatly expanded form by one of his students. It was the result of his gift for elegance and conciseness and his earnest effort to devise a calculus by which the more or less complicated space relations of physics could be conveniently and perspicuously expressed. He also called attention to the great saving of labour, which the use of this calculus would cause in certain astronomical problems such as the determination of orbits and the solution of differential equations giving the perturbations.

### Statistical Mechanics

His last work *Elementary principles in statistical mechanics* (1902) may be said to have supplied one of the great deficiencies in the scientific record of the nineteenth century. In spite of many dogmatic assertions that heat was a mode of molecular motion, this principle had not been put on a firm foundation until Gibbs established that the extra-dynamical laws of heat were consequences of the immense number of independent mechanical systems in any body—a number so great that only certain averages are perceptible. In the first twelve chapters, Gibbs forges out a perfect weapon for attacking the problem and its triumphant use in the last three chapters, makes

the familiar formulæ of thermodynamics appear almost spontaneously.

His collected papers were published in two volumes in 1906 and two volumes of *Commentary* on these papers were published in 1936 to honour his memory.

Gibbs died at New Haven, April 28, 1903.

## Seeley, Harry Govier (1839–1909)

HARRY GOVIER SEELEY, an English palæontologist, was born in London, February 18, 1839. In the early years he found a copy of Lyell's *Principles of geology* in the London Library and this stimulated interest in natural history. Under the old regulations, it was possible for him to gain admission to the British Museum Library even at seventeen. This opportunity he used to the fullest during the next three years. He supplemented his study by attending the lectures of eminent professors like Owen, Forbes and Brayley. He also received encouragement from Woodward of the Geological Department of the British Museum.

When he went to Cambridge in 1859 for literary work, Professor Sedgwick invited him to be his assistant. The regard that the Professor had for the young Seeley is shown by a letter of his, which reads: "In youth, you had a reputation for genius.....It was that reputation which made me seek you out and secure your co-operation as my assistant and fellow-labourer". Till 1871, Seeley stayed in Cambridge and did considerable research work. From 1872, he held various teaching posts in London.

### His Publications

In addition to eight books published between 1870 and 1901, Seeley contributed nearly 200 papers to the organs of learned societies. His ten years' work in the Woodwardian Museum of Cambridge resulted in the publication of the much valued *Index to the fossil remains of Aves, ornithosauria and reptilia* (1869). The most voluminous sequence of his papers entitled *Researches on the structure, organisation and classification of the fossil reptilia* appeared regularly in the *Philosophical transactions* from 1888 to 1896.

### Field Teaching

Besides the valuable addition he made to palæontological knowledge as disclosed by his papers, Seeley did much to popularise scientific knowledge and scientific method. From 1880 to 1890 he gave lectures for the London Society for the Extension of University Teaching and established the London Geological Field Class, in which he conducted excursions week by week for twenty-one years in the summer. And now it has borne fruit in the recognition by the University of London, of Field Teaching as a necessary condition for graduation in Geology.

Seeley died in London, January 8, 1909.

## Verrill, Addison Emery (1839–1926)

ADDISON EMERY VERRIL, an American Marine Zoologist, was born at Greenwood, February 9, 1839. He received his early education at Norway Liberal Institute. Even before his thirteenth year, he had learned to recognise the varieties of rocks and minerals in his native place and had built up a herbarium of several hundred species of wild flowers. At seventeen, he had acquired a collection of the local shells, insects, amphibia, reptiles and mammals and identified them.

In 1859, he entered the Harvard College and came to work under the great Agassiz. Instead of listening to lectures and studying, he was asked by Agassiz what field appealed to him. On replying he was most interested in birds, he was asked to make a study of the goose. After some weeks, when the young Verrill had completed what seemed to him an exhaustive study of the bird's anatomy, Agassiz genially pointed out to him the incompleteness of his investigation and gave him directions for several months' additional work. A new subject was then taken up.

### His Career

Verrill was called to Yale University as its Professor of Zoology in 1864, and he held that post till 1907. From 1871 to 1887 he was also in charge of the scientific work of the United States Commission of Fish and Fisheries. In connection with this, he devised a cradle sieve, a rake dredge and a rope tangle for collecting star fishes in oyster beds.

### Dictionary Work

For several years prior to 1890, he worked on Webster's *International Dictionary* and furnished all the zoological definitions and illustrations.

### His Publications

Verrill was a profuse writer for about 64 years. His contributions number nearly 300. While they cover a wide range, the majority deal with marine invertebrates—particularly those of the Northern New England Coast, the Gulf Stream, the Pacific Coast of Central America, the Bermudas and the West Indies. He estimated that he had discovered a thousand undescribed forms. At eighty-five, still sturdy and vigorous, he extended his exploration to the Hawaiian Islands and discovered many new species. His most exhaustive work is said to be that on corals and cœlenterates, including his studies of the collections of the Canadian Arctic Expedition. Some time before his death, he had placed in the hands of the publishers his monograph on the Alcyoneria consisting of upwards of a thousand pages of manuscripts and 150 plates.

Verrill died at his son's residence in California, December 19, 1926.

## ASTRONOMICAL NOTES

**Planets during March 1939.**—Venus will continue to be visible in the eastern sky for about a couple of hours before sunrise; it is gradually moving towards the Sun and getting fainter. Mercury will be an evening star during the month, and on March 17, reaches greatest elongation (18° 27′ E). Mars is in quadrature with the Sun on March 21 and will be on the meridian at about the time of sunrise; it is becoming brighter, the stellar magnitude being 0·7 about the middle of the month.

Jupiter is in conjunction with the Sun in March 6 and will not be in a favourable position for observation during the month. Saturn continues to be an evening star and will be moving slowly eastward along the southern border of Pisces. Uranus is in the neighbouring constellation Aries, only a degree north of the fifth magnitude star $\sigma$ Arietis; on March 24, the Moon will closely approach the planet. Neptune is in opposition to the Sun on March 13 and its stellar magnitude at the time will be 7·7. The planet will be situated approximately midway between the stars $\beta$ Virginis and $\sigma$ Leonis and can be located with a small telescope.

**Comets.**—Information has been received of the discovery of a comet (1939 *a*) by Cosik at Tashkent on January 17 and independently three days later by Peltier in America (U.A.I. Circular 736, 737). The comet is stated to be a diffuse object with a central condensation and a tail somewhat less than a degree. It was of the eighth magnitude at the time of discovery and has subsequently become brighter. An observation on February 10 shows that the comet was not far from Saturn. A parabolic orbit has been computed by Cunningham and the time of perihelion passage is found to be 1939 February 6. From the ephemeris based on this orbit, the comet appears to be moving rapidly in a south-easterly direction.

**A Supernova.**—Zwicky has reported (U.A.I. Circular 737) the discovery of a supernova in the extragalactic nebula N.G.C. 4636, about 0·6 north-west of the nucleus. The apparent brightness increased from magnitude 14 on January 17 to 12·5 on January 20. These objects are considered to belong to a distinctly separate class of temporary stars whose luminosity at maximum is about a thousand times greater than that of ordinary novæ.

T. P. B.

## SCIENCE NOTES AND NEWS

**The Nichrome-Constantan Thermocouple.**—In a communication, dated January 16, 1939, Messrs. M. R. Mandlekar and P. K. Sathe (Fuel Laboratory, Department of Chemical Technology, University of Bombay) write:—

In connection with the investigations in progress in this laboratory pertaining to industrial classification of Indian Coals, different base metal thermocouples[1] have been used for recording temperatures. The previously covered temperature range (upto 800° C.) has now been required to be extended to 1000° C. Nichrome-Constantan couple which was previously found to be highly satisfactory has been used at the higher temperatures with similar results. It has been observed that the temperature-e.m.f. relationship of the thermocouple, followed over the preliminary temperature range, can be extended to the higher range as well. A straight line relationship is followed over the temperature range covered in this investigation, a characteristic to be valued much in a thermocouple. This relation is followed at temperatures over 300° C. and an algebraic relation between the e.m.f. (*e*, in millivolts) and temperatures (*t*, in ° C.) has been established for temperatures 300–1000° C. for the Nichrome-Constantan thermocouple.

$$t = 14{\cdot}705\, e + 47{\cdot}1.$$

[1] Mandlekar and Banerjea, *J. Soc. Chem. Ind.*, 1938, **57T**, 276; *Curr. Sci.*, 1938, **6**, 447.

**The Electron Microscope.**—When the aperture of a lens is continuously diminished so as to minimise the spherical aberration and thus produce a well-defined image, diffraction effects due to the finite wave-length of light set in and the resolving power suffers in consequence. For this reason complicated lens combinations and ultra-violet light are employed to increase the power of a microscope and yet objects smaller than 0·15$\mu$ cannot be separately distinguished. Now it is known that electrons can be brought to a focus by axially symmetric fields while their de Broglie wave-length being very small, diffraction effects are not produced even when the aperture is drastically cut down. A very thin section of an object mounted on an extremely thin film of nitro-cellulose or sometimes collodion is placed in vacuum in the path of a pencil of electrons which have passed throuh a very small aperture, and they then pass through ironclad coils which behave like the condenser, objective and projection eyepiece of a microscope. They then fall on a fluorescent screen or photographic plate and "silhouette" images having a high degree of magnification (upto 16000) and a resolving limit at present of about 0·01$\mu$ are produced. The pioneer workers in this field have been Knoll, E. Ruska and H. Ruska on the continent. In England similar work has been taken up by Prof. L. C. Martin, who has contributed an article on this subject to *Nature* (1938, 142, 1062) from which the present account has been prepared. A picture of the

apparatus designed by Prof. Martin and reproductions of interesting photographs obtained by Ruska are given in Prof. Martin's article. He there discusses the various difficulties which beset the path of progress in this field. The most important of these difficulties are the production of homogeneous pencils of electrons all having the same velocity (so that 'chromatic aberration' can be got rid of) and the building of ironclad coils, which, besides mechanical symmetry, possess magnetic symmetry to that high degree which is necessary to eliminate the 'spherical aberration' in such 'lenses'. When it is remembered that at present the high magnification to be brought about in two stages requires the whole instrument to be given a length of about two metres, and that the most stringent demands of high vacuum and symmetry have to be met, no one can fail to realise the difficult nature of the work. The effect of the electrons and nuclei of the object illuminated must also be taken into account, while there is also the possibility that the object may be disintegrated by the intense electron beam employed. While the X-ray and Electron-diffraction techniques are most useful in elucidating the regularities of crystalline and other kind of structure, electron microscopy will come in most handy in giving us a knowledge of the discontinuities and irregularities occurring in the same. The future is very bright as regards further improvements in this field and we may hope for the day when even the elements of crystal lattices may be made visible.

T. S. S.

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**Gold in some Fungi.**—Nemec and Babicka (*Chronica Botanica*, 1938, 4, 12) report having succeeded in proving the presence of gold, in traces, in the cells of plants growing on auriferous soils. More recently they have been able to demonstrate its presence in fungi also. Thus the spores of the genus *Polyporus* and their host plants (Beeches, Heinbuche) contain gold in traces.

Two species of *Boletus* (*B. bulbosus* and *B. rufus*) collected in 1935 and 1937 in Westslovakia were analysed. The following results were obtained: *B. bulbosus* (1935): Ash, 6·51; $SiO_2$, 1·28; CuO, 0·10; $Fe_2O_3 + Al_2O_3$, 6·01; CaO, 58·01; MgO, 6·20; $Na_2O$, 5·50; $K_2O$, 4·35; $P_2O_5$, 15·56; $CO_2$, 1·50; $SO_3$, 1·00; Cl, 0·5; Au, 0·0001. (Figures represent percentages of the ash.) The material collected in 1937 showed only a slight variation; but gave rather surprisingly, 0·53 per cent. of ZnO in the ash.

*B. rufus* also showed the presence of gold. This species was analysed for confirmation of the above analytical results. *Dædalea gibbosa*, parasitic on the stems of beech trees, contained also traces of gold.

It would be highly interesting to ascertain whether such absorption of gold is found in plants growing in the Kolar Goldfields area and how far such results could be used in locating auriferous regions.

* * *

**Significance of Trace Elements in Metals and Alloys.**—Non-ferrous metallurgists have devoted considerable attention to the influence of 'trace elements', the term being applied to designate elements present in amounts less than 0·05 per cent. According to the *Instrument Bulletin* (Bausch & Lomb, Rochester, N.Y., Dec. 6, 1938), the lead of commerce contains a number of trace elements—silver, copper, arsenic, antimony, tin, zinc, iron and bismuth, in amounts less than 0·01 per cent. Pure lead (99·999 per cent.) exhibits such low tensile and creep strengths that it is of little commercial interest. Knowledge regarding the effect of trace elements in zinc-base alloys containing about 4 per cent. aluminium has led to significant developments in the die casting industry. An alloy containing only zinc and aluminium (96 of Zn and 4 of Al) has very valuable properties, but if contaminated with traces of lead (0·01 per cent.) and tin (0·005) the castings will not retain their desirable physical properties when exposed to warm, humid atmospheres. Magnesium (0·02 – 0·04 per cent.) is decidedly beneficial and tends to counteract the effects of tin and lead.

* * *

**Rajgir in Ancient Literature.**—Pursuant to its policy of publishing Monographs on India's ancient capitals, the Archæological Survey of India have just brought out, in its series of Memoirs, a Monograph on 'Rajagriha in Ancient Literature', based upon a critical study of various ancient texts. The author is Dr. B. C. Law.

One of the most wonderful cities of ancient India, which goes back to the days of the Buddha and continues to be a place of pilgrimage and a health resort even to the present day, the identification of Rajagriha, still known as Rajgir, is rendered easy by the configuration of the hills by which it is surrounded, the other name of the town being Girivraja, or mountain fastness. The *Mahabharata* mentions Rajagriha as the capital of king Jarasandha, and as the place was hallowed by the presence of the Great Master, it is frequently mentioned in Buddhist literature. Modern excavations have been particularly fruitful at Rajgir and there is, it is said, ample scope for research at this most ancient historical city.

Details are given in the publication of the various names by which the ancient city of Rajagriha was known and their significance as also of the topography of the various sites in and around the city and of the hot springs, the bamboo forest, the mango grove of Jivaka, the Sattapanni cave and other places associated with incidents in the life of the Buddha and the history of Buddhism. The importance of Rajagriha in the religious and cultural history of India is brought out and in particular it is shown how, from the earliest times, Rajagriha was a notable centre of Naga worship—a conclusion confirmed by the recent discoveries of the Archæological Department.

The identification of the five hills that enclose the city has always been a matter of some difficulty and confusion owing to the contradictory writings in different periods. A satisfactory solution is now given of the problem in the Monograph.

* * *

**Official List of Trade Names of Indian Timbers.**—The Forest Research Institute and

College, Dehra Dun, has just brought out a new list of trade names of Indian timbers.

The first official list of trade names for Indian timbers was published in March 1929, and reprinted with a few additions and alterations in 1931.

Since then, experience has shown that the list was by no means perfect. It contained several names which were definitely unsuitable, and in addition several species were included in the list for which trade names were really unnecessary.

The Board of Forestry, which met at Dehra Dun in October 1934, decided, therefore, to publish a revised list of official trade names for Indian woods. The list prepared accordingly had the approval of the Board of Forestry, at which the Head of the Department of Forestry from each Province in India was represented.

The new list of trade names now brought out, is fundamentally the same as that published in 1934. A few necessary alterations and additions have been made, and several common vernacular names added. All Provinces were consulted, and every endeavour has been made to give effect to the suggestions received. In a few cases, where the suggestions of one Province clashed with those of another, the decision of the Inspector-General of Forests has been taken.

The separation of Burma also complicated matters, but it was finally decided to leave in all Burma timbers originally included if they also occurred in India. Other Burma timbers not found in India but imported into India, have been tabulated in a separate list, but included in the present publication.

The list now brought out carries the approval of every Province in India and is published under the authority of the Government of India. It is hoped that Forest Officers and others will do their utmost to further the use of these trade names, with a view to eliminating the confusion caused by the use of local vernacular names, more especially, in export and inter-Provincial trade and in publications.

* * *

**League of Nations: Technical Commission on Nutrition.**—The *Bulletin of the Health Organisation* (Aug. 1938, 7, 4), recently issued, includes the report by the special committee which met in Geneva from August 22nd to 24th, 1938. The Sub-Committee dealt with the guiding principles for the study of the diets and nutrition of populations. Its work in this field resulted in the preparation of a handbook for use in surveys.

The Sub-Committee also noticed the special considerations which arise in connection with nutrition in the Far East, tropical countries and colonial territories. It referred in particular to the necessity of making a closer study of the nutrition value of local foodstuffs and the incidence of diseases directly or indirectly due to dietary deficiencies.

In this connection, the Sub-Committee submitted a programme of studies which, it is hoped, will be organised in 1939 with the assistance of the Nutrition Research Laboratories, Coonoor (India).

Lastly, the Sub-Committee's attention had been drawn to the fact that critical situations exist, even in Europe, where emergency measures are urgently required for famine relief. Its report contains simple and very inexpensive diets sufficient to maintain life and to prevent serious malnutrition. These diets include cereals, milk (whole milk or skim-milk), yeast, cod-liver oil and various salts, so as to provide the necessary vitamins and inorganic elements.

* * *

***Chronicle* of the Health Organisation.**—The Health Organisation branch of the League of Nations which has been issuing a number of publications, relating to subjects which come under its purview, has felt the need for a periodical publication which would keep members of the Organisation's commissions, its various collaborators, doctors, scientists, public health specialists, health departments, scientific institutions and medical reviews and publications, informed of the essential day-to-day activities of the Organisation. After a trial, which proved conclusive, the Health Committee decided to issue the *Chronicle*, the first number of which we have just received. It will appear twice a month and is intended to give an account of the work in progress and to provide informative matter in as succinct a form as possible. The first number contains a report of the recent work of the Permanent Commission on the Biological Standardisation, with regard to anti-toxins and sera. The annual subscription for the *Chronicle* is 5*sh.*

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**Heavy Chemical Industry in India.**—Tata Sons, Ltd., have started a new venture in the Indian Chemical Industry by the manufacture of heavy chemicals in the Baroda State for which the State will give special facilities. The authorised capital of the enterprise is Rs. 5 crores. 1¼ crores will be issued at present.

The company will set up its works near Port Okha which belongs to the Baroda Government, which, besides granting valuable concessions, will subscribe shares to the extent of one-fifth of the present issue. Although the initial programme of the company is confined to the manufacture of basic heavy chemicals such as soda ash and caustic soda, the company contemplates the gradual development of the undertaking so as to embrace practically the whole field of production of heavy chemicals and fertilisers as well as special chemicals for use in industries such as pharmaceutical and photographic.

The scheme is being undertaken after two years of patient and careful preparation and thorough examination at the hands of British, American and other experts, who have satisfied the promoters as to the possibility of working it successfully. (*The Chemical Age*, 1938, 39, 531.)

* * *

At the fifteenth annual general meeting of the **Indian Chemical Society** held on the 7th January at Lahore, the following were elected Office-bearers for 1939:—

*President*: Dr. H. K. Sen; *Vice-Presidents*: Dr. S. S. Bhatnagar, Dr. P. Neogi; *Hon. Secretary*: Dr. P. K. Bose; *Hon. Treasurer*: Dr. A. C.

Sircar; *Hon. Editors*: Dr. J. N. Ray, Prof. P. R. Ray; and *Hon. Auditors*: Mr. P. C. Nandi, Mr. T. K. Roychaudhury.

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**The Entomological Society of India.**—The first annual general meeting of the *Entomological Society of India*, was held on the 4th January 1939 at Lahore during the 26th Session of the Indian Science Congress. The following Office-bearers were elected:—

*President*: Khan Bahadur M. Afzal Husain (Lahore); *Vice-Presidents*: Dr. Hem Singh Pruthi (New Delhi) and Dr. T. V. Ramakrishna Ayyar (Coimbatore); *Secretary and Treasurer*: Dr. K. B. Lal (New Delhi); *Joint Secretary*: Dr. K. D. Baweja (Lyallpur); *Members of the Executive Council*: Dr. N. C. Chatterji (Dehra Dun) and Dr. Khan A. Rahman (Lyallpur); *Editorial Committee*: Dr. Hem Singh Pruthi (Chief Editor), Dr. T. V. Ramakrishna Ayyar, Dr. N. C. Chatterji, Dr. D. R. Mehta, Dr. Khan A. Rahman and the General Secretary (*Ex-officio*).

It was decided to publish an entomological journal from the current year, to be called the *Journal of the Entomological Society of India*. The Office of the Society for the next four years will be located at the Imperial Agricultural Research Institute, New Delhi.

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**The Indian Botanical Society.**—At the Annual General Meeting of the Indian Botanical Society held at Lahore on 7th January 1939, the following persons were elected Office-bearers for the year 1939:—

*President*: Rai Bahadur Professor K. C. Mehta (Agra); *Vice-Presidents*: Mr. H. G. Champion (Nainital) and Dr. H. Chaudhuri (Lahore); *Secretary*: Professor Y. Bharadwaja (Benares); *Treasurer*: Professor M. O. P. Iyengar (Madras); *Executive Council*: Professor S. P. Agharkar (Calcutta). Dr. K. Biswas (Calcutta), Professor S. R. Bose (Calcutta), Professor T. Ekambaram (Madras), Professor S. L. Ghose (Lahore), Dr. E. K. Janaki Ammal (Coimbatore), Dr. A. C. Joshi (Benares), Professor J. H. Mitter (Allahabad), Professor P. Parija (Cuttack), and Professor B. Sahni (Lucknow).

Professor F. E. Fritsch, F.R.S., and Professor A. H. R. Buller, F.R.S., were unanimously elected as Honorary Members of the Society.

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**Indian Committee of Phytosociology and Geobotany.**—At a meeting of the Botany Section held on 7th January 1939 at Lahore, a Committee consisting of the following members was appointed to consider the question of the formation of an Indian Committee of Phytosociology and Geobotany and place recommendations before a joint meeting of different sections at the next meeting of the Congress to be held at Madras in 1940.

*Members of the Committee*: Prof. S. P. Agharkar (Calcutta), Dr. N. L. Bor (Dehra Dun), Dr. F. R. Bharucha (Bombay), Secretary.

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**Benares Hindu University.**—Mr. G. K. Das, M.Sc. (Benares), has been awarded the degree of D.Sc. in Physics by the Benares Hindu University in consideration of his theses on (1) the Doppler Effect of Positive Rays of Hydrogen and its correlation with the Velocity of the Light-emitting Atoms: and (2) the Doppler Displacement with Positive Rays of Mercury.

The research incorporated in these theses was carried out under the supervision of Prof. Dr. Dasannacharya, in the Physics Laboratory of the Benares Hindu University. The theses were examined by Prof. Dr. J. Stark, Nobel-laureate, and Director of the Reichsanstalt for Physik und Technik, and Prof. Dr. E. Rüchardt of the University of München.

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**University of Mysore.**—I. *Examinations*: The results of the Pre-Medical and M.B.B.S. examinations held in December 1938 were published. They were as follows:—

| | | No. Examined | No. Passed |
|---|---|---|---|
| 1. | Pre-Medical .. | 29 | 10 |
| 2. | I M.B.B.S. .. | 25 | 13 |
| 3. | II M.B.B.S. .. | 29 | 19 |
| 4. | Final M.B.B.S. Part I | 21 | 14 |
| | „ Part II | 28 | 14 |

II. *Lectures.*—(*a*) The Appu Rao Extension Lecture, 1938–39, was delivered by Rajadharmapravina Diwan Bahadur Mr. K. S. Chandrasekhara Ayyar, B.A., B.L., retired Chief Judge, Mysore High Court, and Chairman of the Committee on Co-operation in Mysore, on "Co-operation as a Constructive Force" at Bangalore. (*b*) The following lectures were delivered under the Scheme of Extension Lectures during the month:—(i) Miss J. M. Black, M.A., Principal, Maharani's College, on "Trends of the Modern English Stage" in English at Bangalore. (ii) Mr. P. Kodanda Rao, M.A., Servants of India Society, Poona, on "A View of Civilization" in English at Mysore. (iii) Sri. B. Indiramma, M.A., Superintendent, Maharani's Women's Training College, Mysore, on "The Need for the Study of Educational Psychology by Parents" in Kannada at Kolar.

III. *Meeting of the Academic Council.*—A meeting of the Academic Council was held on the 30th January 1939. Among the propositions that were passed, mention may be made of the following:— (1) Holding the final examination for the M.B.B.S. degree twice a year. (2) Institution of Geography as an optional subject of study in the Intermediate and Degree courses. (3) Appointment of a committee to review the working of the course of studies and scheme of examination for the Intermediate and to make suitable recommendation for changes, if necessary. (4) Commencement of the University Session on the 1st June instead of on the 24th and holding University examinations in February–March instead of March–April.

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**University of Bombay: Royal Institute of Science.**—(1) Principal G. R. Paranjpe has been elected a member of the Council of the Indian Science Congress Association. (2) Dr. N. R. Tawde, of the Physics Department has been elected a Fellow (F.Inst.P.) of the Institute of Physics, England. (3) Dr. S. Parthasarathy, an ex-student, has sailed for Sweden to do research work, being awarded a Fellowship by the Nobel Institute, Stockholm. (4) Dr.

F. R. Bharucha has been given further grant by the Bombay Pinjrapole to continue his work on the improvements in grasslands. He is a member of a Committee of the Botany Section of the Science Congress to consider the formation of the Society of Phyto-sociology and Geo-botany.

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Professor F. T. Brooks, F.R.S., Head of the Department of Botany, Cambridge University, has been appointed a Special Reader of the University of Calcutta.

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Dr. R. S. Thakur has been appointed officer-in-charge of the Industrial Survey of Central Provinces and Berar. He has also been appointed a member of the Industrial Survey Committee and also its *Secretary*. Mr. J. C. Kumarappa, B.A., F.S.A.A., who is the organiser and Secretary of the All-India Village Industries Association, Wardha, is the Chairman of the Committee.

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### Announcements

**The Fifth International Congress for the Unity of Science at Harvard University.**—The Fifth International Congress for the Unity of Science will be held at Harvard University from September 5 to 10, 1939.

The theme of the Congress is "The Logic of Science"; interest will centre upon the relation of the concepts, laws and methods of the various sciences. Attention will be devoted to general problems connected with the unification of science, and in particular, with the logic of the physical sciences, the relation of the physical and biological sciences and the relation of the biological and socio-humanistic sciences. There will also be a number of special sessions and symposia connected with special problems and fields.

Professor P. W. Bridgman is the Chairman and Dr. W. V. Quine is the Secretary of the Committee of Arrangements at Harvard University. The Congress is sponsored by the International Committee of the Congress for the Unity of Science, by the International Institute for the Unity of Science, and, in America, by the American Association for the Advancement of Science, the Philosophy of Science Association, the Association for Symbolic Logic and the American Philosophical Association.

A series of twenty monographs entitled "Foundations of the Unity of Science" (and constituting the first two volumes of the "International Encyclopedia of Unified Science"), is now being issued by the University of Chicago Press. It helps to provide a background for the Congress. Three monographs have already appeared, and it is hoped that all the twenty will be in print by the time of the opening of the Congress.

Further information regarding the Congress can be had from Professor C. W. Morris, University of Chicago, Chicago, Illinois.—(*Science*, 1938, 88, 519).)

**10th International Congress of Military Medicine and Pharmacy.**—The organisers of the Congress have since issued an illustrated booklet regarding the Congress, giving the history of the Congress since its first meeting in Brussels (1921), the programme of the meeting, general information to delegates, and short accounts on Washington, the headquarters of the Congress, the Army Medical Centre, the Naval Medical Centre and the Medical Field Service School. The questions to be discussed at the Congress are (1) The organization and function of the Medical Services in Colonial Expeditions, (2) Probable casualties in War and methods of calculation, (3) Practical procedures for Anaesthesia and Analgesia in War Surgery, (4) Organization and function of the Military Chemico-Pharmaceutical Service, (5) Emergency treatment and primary apparatus for fractures of the jaws in War, (6) Technical specialization of administrative officers in the medical service, and (7) Oxygen therapy and its practical use with troops on active service.

**University of Bombay.**—Applications are invited for the post of *Reader in Chemical Engineering* in the Department of Chemical Technology in the scale of Rs. 400–30–550.

Six typewritten copies of the application, made on the prescribed form, together with six copies of certificates, should be forwarded so as to reach the Registrar, University of Bombay, on or before the 1st March 1939.

The name of Mr. Gouripati Chatterjee has been inadvertently omitted in the list of the New Year (1939) awards announced in the previous number of *Current Science*. (January 1939, 8, 42). Mr. Chatterjee is the recepient of the *Rai Bahadur* title.

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We acknowledge with thanks, receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 50, No. 1.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 12.

"Journal of Agricultural Research," Vol. 57, Nos. 10–11.

"The Philippine Agriculturist," Vol. 27, No. 8.

"Biological Reviews," Vol. 14, No. 1.

"Communication from the Boyce Thomson Institute," Vol. 10, No. 1.

"Journal of the Institute of Brewing," Vol. 44, No. 12, and Index to Vol. 44; & Vol. 45, No. 1.

"Journal of Chemical Physics," Vol. 6, No. 12.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 71, No. 12, and Index; Vol. 72, No. 1.

"Chemical Age," Vol. 39, Nos. 1017–18; Vol. 40, Nos. 1019–21.

"Chemical Products," Vol. I, Nos. 2 and 3.

"Experiment Station Record," Vol. 79, No. 6.

"Transactions of the Faraday Society," Vol. 34, No. 213.

"Indian Forest Records" (New Series), Vol. 1, No. 7.

"Forschungan und Fortschritte," Vol. 15, Nos. 1–3.

"Geological, Mining and Metallurgical Institute of India," Vol. 34, No. 3.

"Bulletin of the University of Illinois," Vol. 35, Nos. 101 and 102.

"Communications from the Kamerlingh, Onnes Laboratory of the University of Leiden," Nos. 248–50.
"Bulletin of the Health Organisation of the League of Nations," Vol. 7, Nos. 4 and 5.
"Bulletin of the American Meteorological Society, Vol. 19, Nos. 8 and 9.
"Reviews of Applied Mycology," Vol. 18, No. 1.
"American Museum of Natural History," Vol. 43, No. 1.
"Nature," Vol. 142, No. 3609; and Vol. 143, Nos. 3610–12, and Index to Vol. 142.
"Journal of Nutrition," Vol. 16, No. 6; and Vol. 17, No. 1.
"Research and Progress," Vol. 5, No. 1.
"Sky," Vol. 3, No. 3.
"Canadian Journal of Research," Vol. 16, No. 11.
"Journal of the Royal Society of Arts," Vol. 87, Nos. 4492–96.
"Science Progress," Vol. 33, No. 131.
"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 7, Part IV.
"Proceedings of the Royal Academy of Netherlands, Amsterdam," Vol. 61, Nos. 7 and 8.

**Catalogues**

"Recent Books and New Editions of Standard Works on Chemistry," Messrs. Chapman & Hall, Ltd., London.
"Monthly List of Books on Natural History and Science," January 1939. Messrs. Wheldon & Wesley, Ltd., London.

# ACADEMIES AND SOCIETIES

## Indian Academy of Sciences:

*January* 1939. SECTION A.—S. RANGASWAMI AND T. R. SESHADRI: *Fixation of the Aromatic Double Bonds in the Chromones.* S. RANGASWAMI AND T. R. SESHADRI: *7-Hydroxychromone-8-aldehydes and their conversion into chromono-7 : 8-α-Pyrones.* G. V. L. NARASIMHA MURTI AND T. R. SESHADRI: *The Behaviour of Organic Solids on the Surface of Water.*—The influences of the various groups $-COOH$, $>C=O$, $NH_2$, etc., in a substance on its behaviour on the water surface are discussed. B. R. SETH: *An Application of the Theory of Finite Strain.* S. CHOWLA: *A Remark on* g(n). P. SURYAPRAKASA RAO, V. D. NAGESWARA SASTRI AND T. R. SESHADRI: *Reactivity of the Double Bond in Coumarins and Related Unsaturated Carbonyl Compounds. Part VII. Action of Mercuric Acetate on Hydroxy and 4-Methyl Coumarins.* S. S. PILLAI: *On Waring's Problem with Powers of Primes.* S. RAMACHANDRA RAO AND A. S. NARAYANASWAMI: *Diamagnetism of Some Organic Liquid Mixtures.*—Mixtures of polar liquids have been studied. The derivations from additivity in the case of magnetic susceptibility is much less than in the case of density and refractive index. R. VAIDYANATHASWAMI: *On Continuous Functions of a Real Variable.* S. DUTT: *Chemical Examination of the Essential Oil of* Ocimus sanctum *Linn.*—The essential oil of *Tulsi* contains over 71% eugenol and 20% eugenol methyl ether, with 3% of carvacrol. B. N. SINGH AND N. K. ANANTHA RAO: *A Photo-Electric Nephelometer for Chemical Analysis.*—The intensity of scattered light from an illuminated column of turbid medium is measured by comparison with the light scattered from a standard of turbidity (frosted glass). S. S. BHATNAGAR, M. B. NEVGI AND G. L. OHRI: *The Diamagnetic susceptibilities of Mercury in Various States of combination.*—It is curious to note that the susceptibility constants from the inorganic compounds are different from those derived from organic compounds. The latter closely correspond to those which are obtained for liquid mercury.

*January* 1939. SECTION B.—B. SAHNI: *The Relation of the* Glossopteris *Flora with the Gondwana Glaciation.* C. VIRIKKI: *On the occurrence of similar spores in a lower Gondwana Glacial Tillite from Australia and in Lower Gondwana Shales in India.* S. N. DAS GUPTA AND G. S. VERMA: *Studies in the Diseases of* Mangifera indica *Linn. I. Preliminary Observations on the Necrosis of the Mango Fruit with special reference to the external symptoms of the disease.* G. N. RANGASWAMI AYYANGAR AND D. S. RAJABHOOSHANAM: *A Preliminary Analysis of the Panicle Structure in Sorghum—the Great Millet.* S. B. KAUSIK: *A Cytological Study of* Scœvola lobelia *Linn.* KAILASH CHANDRA MISRA: *A Contribution to the Embryology of the Verbenaceæ.* R. GOPALA AYYAR: *On the Nephridia of* Prionospio cirrifera *Wiren.*

## Botanical Society of Bengal:

*January* 21, 1939.—ROY BASUDEV: *Pollination Studies in prunus.*—These studies carried out at the John Innes Horticultural Institution, Merton, London, reveal (1) In the self-incompatible Cherry, "Noir-de-Schmidt", treatment of the styles with the growth-promoting substances (phenyl acetic acid, naphthol acetic acid and indol acetic acid) has no effect on pollen tube growth. (2) In the self-incompatible plums "Coes Golden Drop", when self-pollinated, the pollen tubes are arrested in the stylar tissue. (3) In compatible and partially compatible pollinations in some plum varieties, it was found that in addition to pollen tubes which travel the full length of the style and effect fertilisation, tubes also occur which are arrested in the stylar tissue indicating two pollen genotypes. (4) In *Prunus divaricata* (diploid) pollinated with *Prunus domestica* (hexaploid), 6 per cent. of fruits set and in the reciprocal pollination 15 per cent. of fruits reached maturity. (5) The rate of growth of a diploid pollen tube in a hexaploid style is more rapid than that of hexaploid pollen tube in a diploid style.

## Meteorological Office Colloquium, Poona:

*January* 27, 1939.—MR. M. P. VAN ROOY: *Meteorological Organisation in South Africa.*